HITACHI 3.5 INCH MAGNETIC DISK DRIVE

Reference Manual

For Ultrastar 15K73

SCSI Interface Specification

Document Number : K6602924

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Preface

This manual describes the specifications of the Small Computer System Interface (SCSI) functions supported by the HITACHI 3 1/2 model magnetic disk drives.

1 GENERAL DESCRIPTION

1.1 APPLICATION

This manual applies to the SCSI logical interface specification of the magnetic disk drive.
Refer to the individual Product Specifications for the physical specification of the product.

1.2 RELATED DOCUMENT

·ANSI SCSI Specification;
ANSI X3.301-1997
X3T10/995D Rev 11a
X3T10/996D Rev 8c
X3T10/1142D Rev 20a
X3T10/1236-D Rev 20
X3T10/1302D Rev 14
X3T10/1416-D Rev 5
X3T10/1365D Rev 10

·Product Specification;
Ultrastar 15K73/36(SCSI Interface) Product Specifications K6602906

1.3 FUNCTION OUTLINE

Interface (SCSI-2).
"Controller or " " may be substituted for the disk drive
describes only SCSI interface functions which are implemented by the SCSI controller in the disk
It s features are listed below.

(1) ANSI STANDARD COMPLIANCE

conform to the ANSI standard listed in article 1.2.

(2) AUTOMATIC ALTERNATE ASSIGNMENT/ACCESS

By the FORMAT UNIT or REASSIGN BLOCKS command, alternate sectors are automatically assigned in place of defective sectors. An alternate sector is allocated next to the defective sector on FORMAT UNIT, so, extra rotational latency may be avoided. The access to an alternate sector is done automatically on the read or write operation.

(3) AUTOMATIC ERROR CORRECTION

The automatic error correction scheme with ECC is capable for an error correction of the medium defect. The On the Fly error correction is also capable for the medium defect and does not require the extra rotational delay.
Refer to the Product Specifications for details.

(4) AUTOMATIC ERROR RETRY

The error recovery function is automatically initiated in case that an error occurred during access to the disk drive.

(5) AUTOMATIC POWER-SAVING CONTROL

The automatic power-saving function is supported to reduce the power consumption and increase the life time of the magnetic heads and the electronic circuits. This is automatically initiated in an idle condition whenever there are no pending process by the host command.

(6) AUTOMATIC READ/WRITE REALLOCATION

The automatic read/ write reallocation function is supported. When an error is detected on reading the data(assuming a data field recoverable error) or writing the data(assuming a servo field error), this function automatically assigns an alternate sector in place of the defective sector and stores the data on the alternated sector prior to sending the completion status.

(7) COMMAND LINK

The command link function transits to next COMMAND phase directly from current MESSAGE IN phase at the successful command termination.

(8) COMMAND QUEUING

One command per initiator(host computer) is enqueued(Untagged Command Queuing) and/or maximum 128 commands as total number of commands from all host computers are enqueued(Tagged Command Queuing).

(9) COMMAND RE-ORDERING

The disk drive executes the multiple tagged commands with the advanced command re-ordering algorithm. It can optimize the execution time of enqueued commands and provide the high performance for a random or multi-threading access environment.

(10) COMPACT DRIVE w/EMBEDDED CONTROLLER

The disk drive with fully embedded SCSI controller has the 3 1/2 inch industrial

standard form factor.

(11) DEFERRED ERROR REPORTING

The deferred error function reports an error to the subsequent command received from the host computer if an error occurs after the completion with the GOOD status returned.

(12) DOWN-LOADABLE SCSI FIRMWARE

The SCSI firmware can be changed by the multi-WRITE BUFFER commands through the SCSI BUS.

(13) FAST-20/FAST-40/Fast-80(Ultra SCSI/Ultra 2 SCSI/Ultra 3 SCSI)

Fast-20(Ultra SCSI), Fast-40(Ultra 2 LVD SCSI), Fast-80(Ultra 3 LVD SCSI), Fast-160 Synchronous Data Transfer Mode and other modes are available as follows.

- Max. 320MB/S (Fast-160 Synchronous w/16-bit bus)
- Max. 160MB/S (Fast-80 Synchronous w/16-bit bus)
- Max. 80MB/S (Fast-40 Synchronous w/16-bit bus)
- Max. 40MB/S (Fast-20 Synchronous w/16-bit bus)
- Max. 20MB/S (Fast-10 Synchronous w/16-bit bus)
- Max. 10MB/S(Synchronous w/16-bit bus)

(14) MULTI-HOST/MULTI-TARGET CONNECTION

The disk drive can be connected to up to sixteen(16) host computers and targets(including itself) in 16-bit Wide SCSI.

(15) MULTI-SEGMENTED BUFFER

The large capacity data buffer is equipped and this is maintained as a multi-segmented buffer. A multi-segmented buffer scheme provides a high performance for a read/write from the host computer which has the multi-tasking feature.
Refer to the Product Specifications for the data buffer size.

(16) READ AHEAD CACHE

The read ahead cache function provides a high performance for a sequential read access. Reading data which the host computer has not yet requested into data buffer is done in advance and directly transferring data to the host computer is done without any latency at sequential access.

(17) SECTOR INTERLEAVE

A 1 : 1 interleave is supported.

(18) SELECTABLE BLOCK LENGTH

A 512 bytes block length is supported as a default and other block length is also available after the disk re-format.
Refer to the Product Specification for details.

(19) SMART(Self-Monitoring Analysis and Reporting)

The SMART(Self-Monitoring Analysis and Reporting) function is supported. This function enables to perform an analysis, logging and reporting the error to the host computer by the disk drive itself .

(20) TRACK/CYLINDER SKEW

In order to avoid a rotational latency for the seek to the adjacent head or cylinder, Head/ Cylinder Skew function which shifts the sector configuration at the head/ cylinder boundary (between the last sector of the head/ cylinder and the first sector of the next head/ cylinder) is supported, so that the read write head can be positioned to the first sector of the next head/ cylinder. Therefore, reading/ writing of contiguous blocks is done without an extra rotational delay, even if an access is done over the physical track/cylinder boundary.

(21) WRITE CACHE

The write cache function provides a high performance for a sequential write access. It may return the completion with the GOOD status for a WRITE command after successfully receiving the data from the host computer and prior to having successfully stored the data on the disk medium.

(22) ULTRA3 SCSI

The Parallel Protocol Request Message and READ BUFFER/WRITE BUFFER command(echo buffer mode) is supported for ULTRA3 SCSI.

(23) SCSI Bus Fairness

The SCSI bus fairness function is supported. This function guarantee the opportunity of an arbitration to all the hosts connected to same SCSI bus, and target.

(24) Information Unit Transfer(IUS)

The Information Unit Transfer(IUS) function is supported. This function can raise the performance of the whole system sharply.
Non-data transmission of the status transmitted to a host can be transmitted and received at synchronization eggplant data transmission speed from the command transmitted to a controller from a host, and controller.
More I/O processes can be processed, without disconnectting.

(25) Quick Arbitration(QAS)

The Quick Arbitration(QAS) is supported. This function can perform an arbitration through a bus free phase.

1.4 GLOSSARY

Bit number	A number that represents the weighted position of one byte. Bit n represents a value of 2^n.
Command Descriptor Block (CDB) :	A command block that is used to communicate requests from an initiator to a target.
Connect	A function used by an initiator to select a target to initiate an operation.
Disconnect	A function used by a target to release the SCSI bus control, allowing the SCSI bus to go to the BUS FREE phase.
XX_H , XXh	A hexadecimal representation of a number (XX with a subscript H/h represents a hexadecimal number).
Initiator	A SCSI device (usually a host computer) that requests another SCSI device to perform an operation.
INTERMEDIATE status	A status code that is sent from a target to an initiator on completion of a command in a set of linked commands except the last command in the set.
I/O Process	An I/O Process is a command process which is requested by an initiator to a target. An I/O Process, in general, begins from an initial selection, through a receiving the CDB and a disconnecting/ reconnecting from/ to an SCSI BUS, and ends by a COMMAND COMPLETE or ABORT/Reset. A set of Linked commands is treated as a single I/O Process.
Logical unit	A physical device that is addressable through a target.
Logical unit number (LUN)	An encoded 6 - bit identifier for a logical unit.
Nexus	A combination on an SCSI interface to perform an I/O Process.
I_T Nexus	A combination of an initiator and a target.
I_T_L Nexus	A combination of an initiator, a target and a logical unit.
I_T_L_Q Nexus	A combination of an initiator, a target, a logical unit and a Queue Tag.

Reconnect	A function used by a target to select an initiator to continue an operation after it has been disconnected.
Reserved (or R)	A term used for a bits, bytes, fields, or code values that are set aside for future standardization.
SCSI address	A unique address 0 - 7 (8 - bit SCSI bus) or 0 - 15 (16 - bit SCSI bus) assigned to an SCSI device. This address is assigned and set in the SCSI device during system installation.
SCSI device	A host computer (w/ SCSI adapter), peripheral controller, or intelligent peripheral that can be attached to the SCSI bus.
SCSI ID bit	The bit significant representation of an SCSI address (this address is associated with a bit number of the data bus).
Status	One byte of information sent from a target to an initiator on completion of each command.
Target	An SCSI device (usually a disk drive w/ SCSI controller) that performs an operation that is requested by an initiator.
Vendor unique (VU)	A bit, byte, field, or code value that can be uniquely specified by each vendor.

2 PRODUCT SPECIFICATION OUTLINE

This chapter describes the logical subjects of Product Specification.
Refer to the Product Specification for physical information which are not included herein.

2.1 ADDRESSING

The host computer addresses the target logical unit (controller and drive) using the methods described below.

(1) SCSI ID

The host computer addresses the SCSI controller by setting the SCSI ID bit of the controller on the data bus.

SCSI IDs are assigned uniquely to each SCSI device (initiators and targets) connected to the same SCSI bus.

(2) Logical unit number

The host computer can address a logical unit in one of the following ways :

· Specifying the logical unit in the logical unit number field of the IDENTIFY message issued after the SELECTION phase.

· Specifying the logical unit in the logical unit number field in the Command Descriptor Block (CDB).

Note : The controller ignores the CDB logical unit number field if the IDENTIFY message was used.

2.2 DISK FORMAT

2.2.1 CYLINDER ALLOCATION

All cylinders on disks are assigned for the system area and the user area. The system area is preserved for the controller's use and may not be accessible from the host computer.

The system area is allocated on both outermost cylinders, and it contains the following types of data ;

- Control parameters (MODE SELECT, INQUIRY and LOG)
- Defect list (manufacture and grown)
- Control program (Downloadable Firmware) etc.

The data in system area is duplicated for data integrity.

The user area consists of the diagnostic cylinder, the data area. The user area, except the data area, may not be accessible from the host computer.

The diagnostic cylinder is allocated for the diagnostic use when the SEND DIAGNOSTIC command is executed and is called "CE Cylinder".

The user data is stored in the data area.

2.2.2 FORMAT PROCESSING

The host computer can format the data area by using FORMAT UNIT and MODE SELECT command.
It can also reallocate each defective block by using REASSIGN BLOCKS command.

Note : This SCSI controller formats the diagnostic cylinder as well as the data area when a Format Unit command is executed.

The outline of the format process is given below. The detail of format processing is shown in the description of ;
·FORMAT UNIT command (Refer to 5.1),
·REASSIGN BLOCKS command (Refer to 5.18)
·MODE SELECT command (Refer to 5.5).

(1) Block Length
The Block Length indicates the byte length which is the minimum unit of data that can be accessed from the host computer.
The default value of block length is 512 bytes.
The block length can be changed by specifying the necessary values of MODE SELECT command in fields given below.

·Block Descriptor	Byte 5,6,7	Block Length
·Format parameter	Byte 12, 13	Data Bytes per physical sector

The value specified in both of these fields should be the same. If the values differ , the value entered in the Block Descriptor will be used.

(2) Alternate Spare Area

The controller allocates 10 local alternate cylinders per notch as an Alternate Spare Area for the defective sector.

(3) Defect Management

Defect management is the assignment of alternate spare sectors for defective sectors caused by media flaws.
The host computer may access the data block as defect-free media by the defect management.
The defect management consists of four schemes based on four defect sources as shown below.

P scheme --- Defects identified by manufacturing process.
These defects are recorded in the system area as P list.
(Primary Defect list)

C scheme --- Defects detected by medium verification.

D scheme --- Defects specified by defect list of FORMAT UNIT command from the host computer.

G scheme --- Defects grown after manufactured.

These defects are detected by previous C and D scheme, and recorded in the system area as G list. (Grown Defect list)

The host computer may specify any combination of defect management schemes with CDB (Command Descriptor Block) of FORMAT UNIT command and defect list.

The controller uses P, C and G schemes as a default mode if the defect management scheme is not specified (i.e., CDB byte 1, Bit 4, FmtData = 0).

(4) Sector Interleave

In order to facilitate speed matching between host bus transfer rate and the disk drive transfer rate, the sector interleave function allows formatting " Physical Block (sector) " and "Logical Block " with a specified interval.
The Interleave value is specified by the CDB of the FORMAT UNIT command, this controller supports sector Interleave factor (n=1) only.

(5) Track Skew

In order to avoid a rotational latency on the head switching, the controller implements Track Skew which shifts the sector arrangement from each other among tracks in the same cylinder.

Figure 2-1 explains the details of Track Skew.

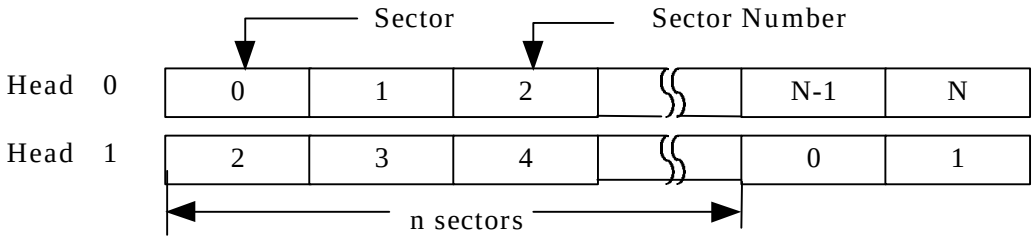

Figure 2-1 Track Skew (Skew Factor n)

(6) Cylinder Skew

The controller implements Cylinder Skew which shifts the sector array between cylinders (i.e., between the last track of a cylinder and the first track of the next cylinder) to avoid a rotational latency when a 1 track seek is performed.

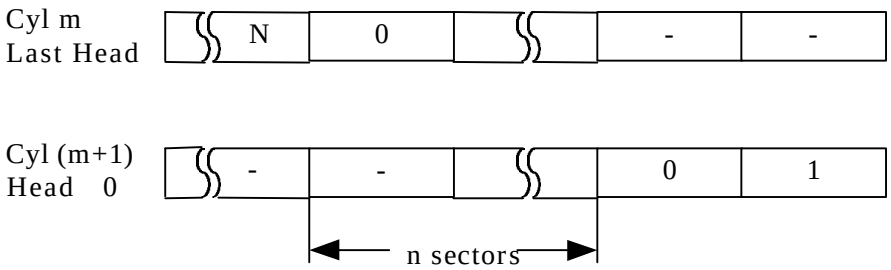

Figure 2-2 Cylinder Skew (Skew Factor n)

When the skew factor n (the physical sector number between the last logical block of a certain cylinder and the first logical block of the next cylinder) corresponds to the 1 track seeking time, the continuous blocks over two cylinders can be accessed with minimum rotational latency.

(7) Format Processing

The controller formats all data area and makes logical blocks accessible from the host computer by FORMAT UNIT command in accordance with specified block length, alternate spare area, defect management, sector interleave and skew factor(s).

All data in the Data Area is deleted by executing the FORMAT UNIT command.

The controller identifies a sector which was specified by defect schemes (P, D and G schemes) as defective, and assigns an alternate spare sector for the defective sector.

The replacement sector is assigned to the next defective sector, to reduce rotational latency.

The controller executes a verification after formatting if C scheme is specified. If an error is found, the controller identifies the error sector as defective and reformats the track and the cylinder.
The controller adds defects identified by D and C schemes to the current G list and saves the new G list in the system area.

(8) Block Reassignment

Unrecoverable error blocks caused by growing defects may be reassigned by the REASSIGN BLOCKS command.
By REASSIGN BLOCKS command, the controller identifies one or more sectors of the specified logical block as defective, and reassigns them as alternate spare sectors.
The error block address (logical block address) is informed to the host computer by information bytes of sense data.
An example of reallocating an alternate spare sector is shown in Figure 2-3.

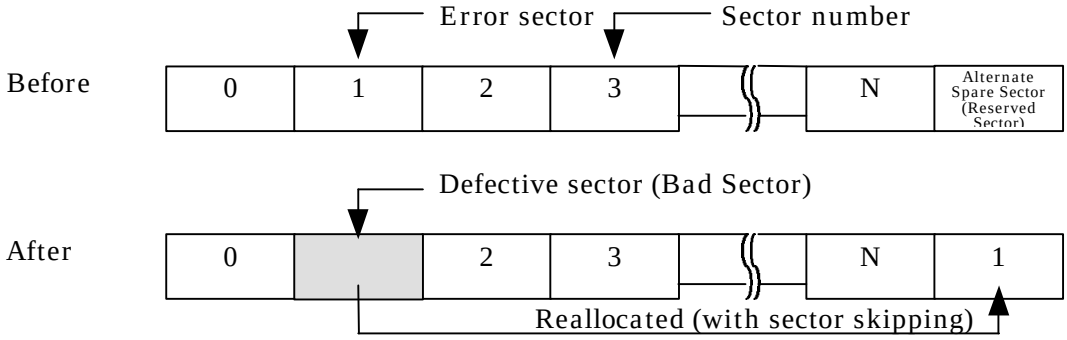

Figure 2-3 Sector Reallocation

(9) Suggestion for Format Processing

· It is required to reformat medium by the FORMAT UNIT command if the block length and/or the number of alternate spare area was changed by the MODE SELECT command.
A command to access the medium is reported the CHECK CONDITION status with the NOT READY sense key and Medium Format Corrupted sense code if the FORMAT UNIT command is not executed after the change with the related Mode parameter.

· This sense key is also reported when the Format command is terminated during a format.

- It is suggested to specify P, G and C schemes (i.e., to use Primary and Grown lists, and to execute verify processing) when specifying defect management.

- The D scheme of defect management is not necessary for normal operation. Since the controller automatically reads P and G lists in system area and formats medium, the host computer does not need to specify the defect.
  The D scheme is convenient for simulating defective sectors for evaluation purpose.

- It is suggested to set TB(Transfer Block) bit in Error Recovery Parameter of the MODE SELECT command and to issue the READ command for an error block if error data is needed for the data recovery of the block which the REASSIGN BLOCKS command is applied to.
  The controller transfers the error block data to the host computer.

2.3 ERROR RETRY

The controller performs the following retry procedures when an error is detected.
The following explanation describes only typical retry method.
The controller may use the retry method which is not described in this manual when an actual retry procedure is taken.

2.3.1 READ ERROR RETRY

The controller retries up to 255 times for read error while utilizing Track offset and/or Slice Level function etc. An error count is made per each sector.
The host computer can change the error management of the controller with the read-write error recovery parameter (Page Code 1_H) of the MODE SELECT command.

2.3.2 WRITE ERROR RETRY

The controller retries up to 255 times with the Slice Level etc.
The host computer can change the error management of the controller with the read-write error recovery parameter (Page Code 1_H) of the MODE SELECT command.

2.3.3 VERIFY ERROR RETRY

The controller performs the same retry as the read error retry mentioned in section 2.3.1 READ ERROR RETRY for the verify error during the verify operation.
The host computer can change the error management of the controller with the verify error recovery parameter (Page Code 7_H) of the MODE SELECT command.

2.3.4 SEEK ERROR RETRY

The controller performs the same retry as the read error retry or write error retry mentioned in section 2.3.1 READ ERROR RETRY and 2.3.2 WRITE ERROR RETRY for seek error during the seek action.

2.3.5 SPINDLE ERROR RETRY

The controller retries the spin up operation 4 times when a start spindle error occurs during execution of the Start Unit command or the Auto Start operation. The controller also retries the spin up operation once when an unexpected spin down error occurs during execution of the medium access command.

2.3.6 ERROR RETRY CONTROL

The host computer can change the number of retries of the controller with the error recovery parameter of MODE SELECT command.
The error recovery parameter may be specified to the controller by each host computer independently.

The summary of error control is explained below.
Refer to the description of 5.5 MODE SELECT command.

(1) Default Mode
The controller specifies the processing given below as Default Mode.

·Executing the following number of retries until error is recovered.

Read Error	128	retries
Write Error	128	retries

·However, if the error in the data field is correctable by ECC the controller corrects the error using ECC, and terminates the recovery procedure (this is applicable when EER=1).

(2) Retry Count

The host computer can select the retry count by specifying the counts to the retry count field of the error recovery parameter.

Notes for Retry Count

·It is recommended to specify the retry count value at more than 128 times in normal operation.

·The controller performs the internal retry before the execution of retries specified by the host computer. If an error is correctable, the controller corrects the error using ECC during the internal retry. When the error is recovered by the internal retry, the controller may not report the recovered error to the host computer even if the PER of MODE Parameter page 01_H is set.

2.4 SUPPORTED SCSI COMMANDS

This SCSI controller supports the group 0,1,2 and 5 commands listed in Table 2.1 based on SCSI-2 command set and additionally some SCSI-3 command set.

Table 2.1 Commands Supported

Operation Code	Group 0 Command Name	Reference
00_H	TEST UNIT READY	5.32
01_H	REZERO UNIT	5.26
03_H	REQUEST SENSE	5.23
04_H	FORMAT UNIT	5.1
07_H	REASSIGN BLOCKS	5.18
08_H	READ	5.11
$0A_H$	WRITE	5.34
$0B_H$	SEEK	5.27
12_H	INQUIRY	5.2
15_H	MODE SELECT	5.5
16_H	RESERVE	5.24
17_H	RELEASE	5.20
$1A_H$	MODE SENSE	5.7
$1B_H$	START/STOP UNIT	5.30
$1C_H$	RECEIVE DIAGNOSTIC RESULTS	5.19
$1D_H$	SEND DIAGNOSTIC	5.29

(cont'd)

Table 2.1 Commands Supported (cont'd)

Operation Code	Group 1 Command Name	Reference
25_H	READ CAPACITY	5.14
28_H	READ (EXTENDED)	5.12
$2A_H$	WRITE (EXTENDED)	5.35
$2B_H$	SEEK (EXTENDED)	5.28
$2E_H$	WRITE AND VERIFY	5.36
$2F_H$	VERIFY	5.33
35_H	SYNCHRONIZED CACHE	5.31
37_H	READ DEFECT DATA	5.15
$3B_H$	WRITE BUFFER	5.37
$3C_H$	READ BUFFER	5.13
$3E_H$	READ LONG	5.17
$3F_H$	WRITE LONG	5.38
Operation Code	Group 2 Command Name	Reference
41_H	WRITE SAME	5.39
$4C_H$	LOG SELECT	5.3
$4D_H$	LOG SENSE	5.4
55_H	MODE SELECT (10)	5.6
56_H	RESERVE(10)	5.25
57_H	RELEASE(10)	5.21
$5A_H$	MODE SENSE (10)	5.8
$5E_H$	PERSISTENT RESERVE IN	5.9
$5F_H$	PERSISTENT RESERVE OUT	5.10
Operation Code	Group 5 Command Name	Reference
$A0_H$	REPORT LUNS	5.22
$B7_H$	READ DEFECT DATA(12)	5.16

This SCSI controller does not support the group 0, 1 and 2 commands listed in Table 2.2 based on SCSI-2 command set.

Table 2.2 Commands Not Supported

Operation Code	Group 0 Command Name
18_H	COPY
$1E_H$	PREVENT/ALLOW MEDIUM REMOVAL
Operation Code	Group 1 Command Name
30_H	SEARCH DATA HIGH
31_H	SEARCH DATA EQUAL
32_H	SEARCH DATA LOW
33_H	SET LIMITS
34_H	PRE-FETCH
36_H	LOCK/UNLOCK CACHE
39_H	COMPARE
$3A_H$	COPY AND VERIFY
Operation Code	Group 2 Command Name
40_H	CHANGE DEFINITION

3 SCSI BUS

This chapter describes the SCSI bus interface that is common to all SCSI controller commands. Refer to the appropriate specifications or documents for the physical specifications, SCSI bus signal definitions, bus phases, and bus signal timings of the SCSI bus.

3.1 SCSI BUS FUNCTIONS

3.1.1 COMMAND RECEPTION

This SCSI controller can receive commands from a maximum of 7 (15 for Wide SCSI) host computers (initiators).

When the controller receives a new command while executing or enqueuing a previous command from the same host computer, it informs the "Busy" status to the new command, except during Tagged Queuing.

3.1.2 COMMAND QUEUING

(1) Untagged Queuing

The controller can enqueue one command for each host computer when it cannot execute the received command immediately (there is already an enqueued or executing command).

The controller, however, does not enqueue the received command and reports the Busy status in the following cases:

· The controller cannot disconnect from the SCSI bus after receiving the CDB, that is, bit 6 of the Identify message is set to 0 (the host computer does not support disconnect or reconnect function) or the Disconnect message from the controller is rejected.

The controller executes the queued commands with the FCFS (First Come First Served) algorithm.

(2) Tagged Queuing

The host computer can issue plural commands for a logical unit by using the Queue Tag message. The controller contains a single queue slot which can enqueue SCSI commands from a single or multiple hosts up to 128 commands. The controller selects a queued command and executes it based on the command type of the Queue Tag message specified by the host computer.
The host computer can not issue a tagged command and an untagged command at a same time, nor issue a duplicated tagged command (Same tag Number) at a same time.

3.1.3 DISCONNECT / RECONNECT

This SCSI controller disconnects from and reconnects to the SCSI bus during command execution to make up the SCSI bus available to other SCSI devices.

For the controller to disconnect, the host computer must take the following actions :

· Sets the host computer ID bit for the SCSI ID bit in the SELECTION phase.

· Sets bit 6 (Disconnection/Reconnection Available) of the Identify message to 1 after the SELECTION phase.

· Receives the Save Data Pointer and Disconnect messages from the controller.

(1) Disconnect

The controller disconnects from the SCSI bus when :

· It enqueues a command and cannot execute it immediately.

· It is occurred one of the following conditions and the SCSI Bus is held inactive without handshaking :

(2) Reconnect

The controller, once it disconnects from the SCSI bus, reconnects to the SCSI bus whenever it becomes necessary to continue the current operation (normally transfer data or report status).

For reconnect operation, the controller waits until SCSI Bus is free, and after it gains control of the Bus by ARBITRATION and reselects the host computer.
This operation is repeated until the controller gains control of the Bus.

3.1.4 UNIT ATTENTION CONDITION

A unit attention condition occurs whenever the Mode Select parameter or the Log Select parameter for the logical unit is updated or when the controller is reset (by the Bus Device Reset message, hardware reset, or power-on reset).

The unit attention condition is informed for the host computers other than that which updated the Mode Select parameter or for all the host computers when the controller is reset.
The unit attention state is maintained for each host computer.

Once the controller is put into the unit attention condition, it reports the CHECK CONDITION status for commands other than the Request Sense and Inquiry commands. In this case, the controller sets the Unit Attention Sense Key as sense data. After sending the Check Condition status, the controller enters in the usual sense data pending state.

When the controller receives an Inquiry command from a host computer in the unit attention state, it executes the Inquiry command and remains in the unit attention state.

When the controller receives a Request Sense command from a host computer in the unit attention state, it sends the pending sense data to the host computer and remains in the unit attention state.
If there is no pending sense data for the host computer, the controller returns the sense data containing the Unit Attention Sense Key without reporting the CHECK CONDITION status. In this case, the unit attention state is cleared.

3.1.5 ATTENTION CONDITION

The host computer informs the controller that it is ready to send a message to the controller by using an attention condition.
Except in the Arbitration and Bus Free phases, the host computer can generate attention conditions asynchronously by asserting ATN signal.

3.1.6 RESET CONDITION

Reset conditions are used to clear all SCSI data on the SCSI bus immediately.
The reset condition takes precedence over any other phases and conditions.

The host computer can generate reset conditions asynchronously by asserting and holding on RST signal for the minimum reset hold period.

This SCSI controller cannot generate the RST signal.

Once a reset condition occurs, the controller takes the following actions using a hardware reset option :

- Clears all uncompleted commands.
- Releases all SCSI device reservations.
- Clears the negotiation of synchronous data transfer and goes to the Asynchronous data transfer mode.
- Clears the negotiation of 16 bit-wide data transfer and goes to the 8 bit data transfer mode.

After the reset condition, the controller enters the Bus Free phase.

3.2 MESSAGES

The message system allows the communications between the host computers (initiators) and controllers (targets) for physical path management.

3.2.1 MESSAGE PROTOCOL

The SCSI device indicates that it can respond to messages other than the Command Complete message by sending or responding to the ATN signal. The host computer indicates this capability in the Selection phase by asserting an ATN signal before the SEL signal asserting and the BSY signal negating. The controller indicates to the host computer that it can respond to messages other than Command Complete by responding to the attention condition in the Message Out phase following the Selection phase.

If the host computer does not send the ATN signal in the Selection phase, the controller uses only the Command Complete message.

The first message that the host computer sends after the Selection phase must be the Identify message. This message sets up a physical path for the logical unit specified by the host computer.
The Identify message is also issued by the controller for the first time after the Reselection phase. This message sets up again a physical path for the logical unit specified by the controller. Under exceptional conditions, the host computer can send the Abort or Bus Device Reset message as the first message instead of the Identify message.

3.2.2 MESSAGES

The Table 3.1 lists the message supported by the controller.

Table 3.1 Messages

Code	Description	Direction	Remarks
00_H	COMMAND COMPLETE	In	
01_H	EXTENDED MESSAGE	In Out	Refer to 3.2.3
02_H	SAVE DATA POINTER	In	
03_H	RESTORE POINTERS	In	
04_H	DISCONNECT	In	
05_H	INITIATOR DETECTED ERROR	Out	
06_H	ABORT(or ABORT TASK SET)	Out	
07_H	MESSAGE REJECT	In Out	
08_H	NO OPERATION	Out	
09_H	MESSAGE PARITY ERROR	Out	
$0A_H$	LINKED COMMAND COMPLETE	In	
$0B_H$	LINKED COMMAND COMPLETE (WITH FLAG)	In	
$0C_H$	BUS DEVICE RESET (or TARGET RESET)	Out	
$0D_H$	ABORT TAG(or ABORT TASK)	Out	
$0E_H$	CLEAR QUEUE	Out	
12_H	CONTINUE I/O PROCESS	Out	
13_H	TARGET TRANSFER DISABLE	Out	
20_H	SIMPLE QUEUE TAG	In Out	2-byte message
21_H	HEAD OF QUEUE TAG	Out	2-byte message
22_H	ORDERED QUEUE TAG	Out	2-byte message
23_H	IGNORE WIDE RESIDUE	In	2-byte message
55_H	QAS REQUEST	In	
80_H - FF_H	IDENTIFY	In Out	

In : Controller (Target) to Host (Initiator)
Out : Host (Initiator) to Controller (Target)

Command Complete (00_H)
This message is sent from the controller to the host computer to indicate that the execution of a command is complete and that a valid status has been sent to the host computer. After sending this message, the controller releases the BSY signal and enters the Bus Free phase.

Extended Message (01_H)
This message is sent from either the host computer or the controller as the first byte of a multiple-byte message. (see 3.2.3 for description of extended messages.)

Save Data Pointer (02_H)
This message is issued by the controller to direct the host computer to save the copy of the current active data pointer of the currently connected logical unit. The data to be transferred after this message will be the following part to the data already
transferred, that is, the already transferred data won't be transferred again after this message.

Restore Pointers (03_H)
This message is issued by the controller to direct the host computer to restore the last saved pointers (for the currently connected logical unit) to the active state. This message is used to restore the pointers in case of other than a reconnection after a disconnection.

Precautions to observe on the host computer side;
The pointers to the command to the logical unit, data, and status must be restored to the active pointer.
The pointers to the command and status must be restored at the beginning of the current command and status areas.
The data pointer shall be restored at the beginning of the data area if no Save Data Pointer message has been issued and otherwise in the pointer area indicated in the last Save Data Pointer message for the current logical unit.

Disconnect (04_H)
This message is sent from the controller to the host computer to indicate that the current physical path is being disconnected (the controller is about to disconnect from the SCSI bus by releasing the BSY signal) but that a later reconnection is required to complete the current operation.

Note : To split a long sequence of transfer data into two or more shorter blocks of transfer data with the Disconnect message (include the cases caused by error retries), the controller sends a Save Data Pointer message prior to the Disconnect message.

Initiator Detected Error (05_H)
This message is sent from the host computer to the controller to indicate that a retriable error (e.g., parity error with the SCSI bus) has occurred.

Abort(or Abort Task Set) (06_H)
The controller will go to the BUS FREE phase following successful receipt of this message. The controller will clear the active I/O process plus any queued I/O process for the I_T_x nexus.
The pending data, status and queued I/O processes for any other I_T_x nexus will not be cleared.

Note : If only I_T nexus has been established, no IDENTIFY message is available, the controller will go to the BUS FREE phase. No pending data, status and no other I/O process will be affected.

Message Reject (07_H)
This message is sent from the host computer or controller to indicate that the last received message is invalid or not supported. To indicate an intention to send this message, the host computer must assert the ATN signal before releasing the ACK signal of the REQ/ACK handshake for the message to be rejected.

The controller switches into the message in phase before sending this message.

No Operation (08_H)
This message is sent from the host computer in response to the message request from the controller to indicate that it has no valid message to be sent to the host computer.

Message Party Error (09_H)
This message is sent from the host computer to the controller to indicate that a parity error is found in one or more bytes of the last received message. To indicate an intention to send this message, the host computer must assert the ATN signal before releasing the ACK signal of the REQ/ACK handshake for the message in parity error.

Linked Command Complete ($0A_H$)
This message is sent from the controller to the host computer to indicate that the execution of a linked command (with the flag bit set to zero) has completed and that status has been sent.
The controller goes to the Command phase after sending this message.

Linked Command Complete (with Flag) ($0B_H$)
This message is sent from the controller to the host computer to indicate that the execution of a linked command (with the flag bit set to one) has completed and that status has been sent. The controller goes to the Command phase after sending this message. This message can be used to cause an interrupt in the host computer between two linked commands.

Bus Device Reset(or Target ResetT ($0C_H$)
This message is issued by the host computer to direct the controller to cancel all of the current commands issued on the drive. This message forces the SCSI device into the initial state (no pending state) for all host computers. On recognize this message, the controller enters the

Abort Tag(or Abort Task) ($0D_H$)
The controller will go to the BUS FREE phase following successful receipt of this message.

This message is sent from the host computer to the controller to clear the current I/O process and any pending status or data for this I/O process. If the execution of the I/O process has already been started by the controller, the execution will be halted.
The pending data, status and queued I/O process for any other I_T_x nexus will not be cleared.

Clear Queue(or Clear Task Set) ($0E_H$)
The controller will go to the BUS FREE phase following successful receipt of this message. The controller will perform an action equivalent to receiving a series of ABORT message from each initiator. All I/O processes, from all initiators, in the queue will be cleared. All pending status and data for all the initiators will be cleared.
A Unit Attention with the additional sense code of COMMANDS CLEARED BY ANOTHER INFORMATION will be generated to all other initiators with I/O processes that either were active or queued.

Continue I/O Process (12_H)
This message is sent from the host computer to the controller to reconnect and

Out phase as the Identify message. Thus, the host computer must sent the Identify, Queue Tag (if any) and Continue I/O Process in order at the Message

The controller can go to Bus Free phase again by sending Disconnect message if the conspicuous delay occurs until restarting the reconnected I/O process. The

Message Reject message.
If there is no I/O process for the nexus which sent this message, the controller

The host computer can know whether or not the controller supports this message by checking TranDis bit in the Standard Inquiry data (See 5.2) .

Target Transfer Disable (13_H)

computer to do the reconnections for data transfer on the I/O process. The controller reconnects to the host computer only for the other purpose of

This message must be sent as the last message on the Message Out phase of the initial selection sequence. The controller will continue the I/O process,

message. Once the disconnect occurs, the controller will not reconnect to transfer data. The controller will not enter a Data In phase on the initial

message) .

When the controller is ready to transfer data for a disconnected I/O process for

Reselection phase.

The controller sends the Identify, Queue Tag (if any) and Disconnect in order at

If the host computer rejects the disconnect message with the Message Reject message, the controller will enter a Data phase to transfer data. If the host

message, the controller will go to Bus Free phase.
When data is ready to be transferred, the host computer can reconnect the

message) .
The host computer can know whether or not the controller supports this

Queue Tag Message (20_H $_H$)

	Description
0	H, 21 or 22H
1	Queue Tag (00 - FFH

Simple Queue Tag (20_H)
This message specifies that the I/O process will be placed in the logical unit's command queue. The order of execution is defined by the controller.

Head Of Queue Tag (21_H)

unit's command queue. An I/O process already being executed by the controller will not be preempted. A subsequent I/O process received with this message will

order.

Ordered Queue Tag (22_H)
This message specifies that the I/O process will be placed in the logical unit's

the logical unit received prior to this I/O process will be executed before this I/O process is executed. All queued I/O processes received after this I/O process will

Head Of Queue Tag message.

Ignore Wide Residue (23_H)

Byte	
0	Message Code (23)
1	H, 02 , 03_H

This message is sent from the controller to the host computer(initiator) to indicate that the number of valid bytes sent during the last REQ/ACK

message will be sent immediately following the DATA IN phase and prior to any other message. The ignore field is defined as follows.

	Ignore field of 16-bits transfer
00	Reserved
01	DB (15-8)
02	Reserved
03	Reserved
04 -FF_H	

QAS Request (55_H)
The controller set this message to at the time of the Quick Arbitration phase start after information until transmission and

Identify (80_H through FF_H)

physical path between the host computer and the controller for a specified logical unit.

This bit is always set to 1 to distinguish this message from the other messages.

This bit can be set to 1 only by the host computers. When set to l, bit 6 indicates that the host computer has the ability to accommodate

Bits 5-0 (Logical Unit Number = 0_H
These bits represent the logical unit number in the controller.

Only one logical unit number can be identified during one selection sequence.

specifying a new logical unit number before the bus is freed (Bus Free phase).When this message is sent from the controller to the host computer

Pointers message before the completion of this message.

3.2.3 EXTENDED MESSAGE

The extended message is indicated by (01) in the first byte of a message and consists of multiple-bytes.

TRANSFER REQUEST message, the WIDE DATA TRANSFER REQUEST message and PARALLEL PROTOCOL REQUEST message.

Synchronous Data Transfer Request ($010301mmXX_H$)

Table 3.2 SYNCHRONOUS DATA TRANSFER REQUEST

Byte	Value	Description
0	01_H	Extended message
1	03_H	Extended message length
2	01_H	SYNCHRONOUS DATA TRANSFER REQUEST code
3	mm_H	Transfer period (mm_H times 4 nanoseconds)
4	XX_H	REQ / ACK offset

The SYNCHRONOUS DATA TRANSFER REQUEST message negotiates the synchronous data transfer-rate between the host computer and the controller.

If the host computer requests the synchronous data transfer, it shall negotiate with the controller by SYNCHRONOUS DATA TRANSFER REQUEST message since the default transfer mode of the controller is asynchronous data transfer.

The controller may negotiate with each host computer by SYNCHRONOUS DATA TRANSFER REQUEST message released by host computers, it does not request the negotiation by sending this message from the controller.
This negotiation is valid until RESET condition is occurred (receipt of BUS DEVICE RESET message, " hard " RESET or POWER ON RESET) or the renegotiation is executed.

Note : In order to keep better performance, it is suggested for user not to negotiate at each SELECTION.

The SYNCHRONOUS DATA TRANSFER REQUEST message is received after receipt of IDENTIFY message of SELECTION phase (includes SCSI ID for both the host computer and the controller).

In accordance with SYNCHRONOUS DATA TRANSFER REQUEST message from the host computer, the controller respond with either SYNCHRONOUS DATA TRANSFER REQUEST or MESSAGE REJECT message.

Table 3.2 shows SYNCHRONOUS DATA TRANSFER REQUEST message which is used for both the request from the host computer and the response from the controller.

The extended message length specifies the length in bytes of the following bytes (03_H). The extended message length does not include itself.

$_H$ in byte 2 indicates SYNCHRONOUS DATA TRANSFER REQUEST

The transfer period(mm$_H$
allowed between leading edges of successive REQ signals and successive ACK signals (period of REQ signal and ACK signal).

$_H$) is the maximum number of REQ signals allowed to be

A REQ / ACK offset value of zero indicates asynchronous mode , a value of FF$_H$

Table 3 3 Transfer period

Initiator Request	Target Response		
		Maximum Burst Rate	Transfer Period
0 H - A H	A H	40.00 MB/s	25 ns
B H - C H	C H	20.00 MB/s	50 ns
D H - 19 H	19 H	10.00 MB/s	100 ns
1A H - 32 H	32 H	5.00 MB/s	200 ns
33 H - FF H	Request value	N/A	(Async.Mode)

If the established data transfer width is 16 bits, the controller executes data transfer with two times Maximum Burst Rate.

The negotiation between the host computer and the controller is shown in the following way ;

Controller's Response	Implied Agreement
(1) Transfer period equal to or greater than requested value, and REQ / ACK offset equal to or less than requested value.	Transfer period and REQ / ACK offset equal to the controller's value.
(2) REQ / ACK offset equal to 0$_H$	Asynchronous transfer.
(3) MESSAGE REJECT	Asynchronous transfer.

When the host computer responds with MESSAGE REJECT message to SYNCHRONOUS DATA TRANSFER REQUEST message from the controller or when the host computer can not receive the message successfully (message parity error), the negotiation is canceled and the controller goes to Asynchronous data transfer mode.

Note : The negotiation is agreed if the host computer responded with ABORT message .

Precautions on the host computer side

The transfer period of synchronous data transfer is based on the transfer capability of SCSI bus and it is not limited by transfer capability of DMA.
The shortage of DMA transfer capability is accommodated by REQ / ACK offset (Max. No. of REQ pulses that may be sent prior to receipt of corresponding ACK pulses.).
After REQ / ACK offset value reaches to the maximum, it is avoided to transmit the next REQ signals until ACK signals are received.

Wide Data Transfer Request ($010203XX_H$) (Only for wide SCSI drive)

Table 3.4 WIDE DATA TRANSFER REQUEST

Byte	Value	Description
0	01_H	Extended message
1	02_H	Extended message length
2	03_H	WIDE DATA TRANSFER REQUEST code
3	XX_H	Transfer width exponent

The WIDE DATA TRANSFER REQUEST message is sent from the host computer to the controller to establish the width of the data path to be used for DATA transfer phases (applicable to DATA IN and DATA OUT phases only).

Table 3.4 shows wide data transfer request. Extended message length is specified the number of bytes transferred following this length (It does not include itself).
The code 03_H in byte 2 indicates WIDE DATA TRANSFER REQUEST message.

The value responded by the controller corresponding to the TRANSFER WIDTH EXPONENTS(XX_H) specified from the host computer is shown in Table 3.5.

Table 3.5 TRANSFER WIDTH EXPONENTS

Request Value	Response Value	Bus Width
00_H	$n = 00_H$	8 Bits
01_H	$n = 01_H$	16 Bits
02_H	$n = 01_H$	16 Bits
03_H-FF_H	$n = 01_H$	16 Bits

Note : The agreement may become invalid after any condition which may leave the data transfer agreement in a indeterminate state as follows :
·after a Hard Reset condition
·after a BUS DEVICE RESET message
·after a Power on Reset condition.

Note : If a synchronous data transfer agreement is in effect, the controller that accepts a WIDE DATA TRANSFER REQUEST message resets the synchronous agreement to asynchronous mode.

Parallel Protocol Request ($010604XX00XXXXXX_H$)

Table 3.6 PARALLEL PROTOCOL REQUEST

Byte	Bit	Value	Description
0	7-0	01_H	Extended message
1	7-0	06_H	Extended message length
2	7-0	04_H	PARALLEL PROTOCOL REQUEST code
3	7-0	mm_H	Transfer period (mm_H times 4 nanoseconds)
4	7-0	00_H	Reserved
5	7-0	XX_H	REQ / ACK offset
6	7-0	XX_H	Transfer Width Exponent
7	7	X	PCOMP_EN(Precompensation Enable)
	6	X	RTI(Retain Training Information)
	5	X	RD_STRM(Read Streaming and Read Flow Control Enable)
	4	X	WR_FLOW(Write Flow Control Enable)
	3	X	HOLD_MCS(Hold Margin Control Settings)
	2	X	QAS Request(0:Disable, 1:Enable)
	1	X	DT Request(0:ST mode, 1:DT mode)
	0	X	IU Request(0:Disable, 1:Enable)

Byte7 bit6-0 of a PARALLEL PROTOCOL REQUEST is called Protocol Option Bits.

The PARALLEL PROTOCOL REQUEST message negotiates the synchronous data transfer agreement, the wide data transfer agreement, and set the protocol options between the host computer and the controller.

If the host computer requests the synchronous data transfer, the wide data transfer, it shall negotiate with the controller by PARALLEL PROTOCOL REQUEST message since the default transfer mode of the controller is asynchronous data transfer and data transfer width 8 bits.

The controller may negotiate with each host computer by PARALLEL PROTOCOL REQUEST message released by host computers, it does not request the negotiation by sending this message from the controller.
This negotiation is valid until RESET condition is occurred (receipt of BUS DEVICE RESET message, " hard " RESET or POWER ON RESET) or the renegotiation is executed.

Note : In order to keep better performance, it is suggested for user not to negotiate at each SELECTION.

The PARALLEL PROTOCOL REQUEST message is received after receipt of IDENTIFY message of SELECTION phase (includes SCSI ID for both the host computer and the controller).

In accordance with PARALLEL PROTOCOL REQUEST message from the host computer, the controller respond with either PARALLEL PROTOCOL REQUEST or MESSAGE REJECT message.

Table 3.6 shows PARALLEL PROTOCOL REQUEST message which is used for both the request from the host computer and the response from the controller.

The extended message length specifies the length in bytes of the following bytes(06_{H}). The extended message length does not include itself.

The code 04_{H} in byte 2 indicates PARALLEL PROTOCOL REQUEST message.

The Transfer period(mm_{H}) specifies the minimum time (4 ns as increment) allowed between leading edges of successive REQ signals and successive ACK signals (period of REQ signal and ACK signal).

The REQ / ACK offset(XX_{H}) is the maximum number of REQ signals allowed to be outstanding before its corresponding ACK signal is received at the controller.

A REQ / ACK offset value of zero indicates asynchronous mode, a value of FF_{H} indicates unlimit offset.

The Transfer width exponent value responded by the controller corresponding to transfer width exponents(XX) specified from the host computer is shown in Table 3.5.

The PCOMP_EN specifies the select Precompensation enable or disable.

The RTI specifies the select Retain Training Information enable or disable.

The RD_STRM specifies the select Read Streaming and Read Flow Control enable or disable.

The WR_FLOW specifies the select Write Flow Control enable or disable.

The HOLD_MCS specifies the select Hold Margin Control Settings enable or disable.

The QAS Request specifies the negotiate of QAS.

A QAS Request value of zero indicates disable QAS, a value of 1 indicates enable QAS.

The DT Request specifies the select ST data phase or DT data phase..

The value responded by the controller corresponding to the DT Request specified from host computer is shown in Table 3.7.

Table 3.7 DT Request

Request Value	Response Value	DATA phase
0	0	ST Data phase
1	0	ST Data phase
1	1	DT Data phase

The IU Request specifies the negotiate of IUS.

A IU Request value of zero indicates disable IUS, a value of 1 indicates enable IUS.

Table 3.8 Transfer period

Initiator Request		Target Response		Controller Execution	
Transfer Period(HEX)	DT Request	Transfer Period(HEX)	DT Request	Maximum Burst Rate	Target Transfer Period
0 H - 8 H	1	8 H	1	160.00 MB/s	6.25 ns
9 H	1	9 H	1	80.00 MB/s	12.5 ns
A H	1	A H	1	40.00 MB/s	25 ns
0 H - A H	1/0	A H	0	40.00 MB/s	25 ns
B H - C H	1	C H	1	20.00 MB/s	50 ns
B H - C H	0	C H	0	20.00 MB/s	50 ns
D H – 19 H	1	19 H	1	10.00 MB/s	100 ns
D H – 19 H	0	19 H	0	10.00 MB/s	100 ns
1A H - 32 H	1/0	32 H	0	5.00 MB/s	200 ns
33 H - FF H	1/0	Request value	0	N/A	(Async.Mode)

If the established data transfer width is 16 bits, the controller executes data transfer with two times Maximum Burst Rate.

The negotiation between the host computer and the controller is shown in the following way ;

Controller's Response	Implied Agreement
(1) Transfer period equal to or greater than requested value, and REQ / ACK offset equal to or less than requested value.	Transfer period and REQ / ACK offset equal to the controller's value.
(2) REQ / ACK offset equal to 0_H	Asynchronous transfer.
(3) MESSAGE REJECT	Asynchronous transfer.

When the host computer responds with MESSAGE REJECT message to PARALLEL PROTOCOL REQUEST message from the controller or when the host computer can not receive the message successfully (message parity error), the negotiation is canceled and the controller goes to Asynchronous data transfer mode.

Note : The negotiation is agreed if the host computer responded with ABORT message .

Precautions on the host computer side

The transfer period of synchronous data transfer is based on the transfer capability of SCSI bus and it is not limited by transfer capability of DMA.

The shortage of DMA transfer capability is accommodated by REQ / ACK offset (Max. No. of REQ pulses that may be sent prior to receipt of corresponding ACK pulses.).
After REQ / ACK offset value reaches to the maximum, it is avoided to transmit the next REQ signals until ACK signals are received.

3.3 STATUS

The status byte is defined as summarized in Table 3.9 and Table 3.10. It is sent from the controller to the host computer in the Status phase at the end of a command, except in case the command is canceled by a Abort message, Abort Tag message, Clear Queue message, Bus Device Reset message, or one of reset conditions (including Power On Reset).

Table 3.9 Status Byte Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved 0	Reserved 0	Status Byte Code					Reserved 0

Table 3.10 Status Byte Code

Bits of Status Byte					Status
5	4	3	2	1	
0	0	0	0	0	GOOD
0	0	0	0	1	CHECK CONDITION
0	0	1	0	0	BUSY
0	1	0	0	0	INTERMEDIATE / GOOD
0	1	1	0	0	RESERVATION CONFLICT
1	0	1	0	0	QUEUE FULL

The status byte codes are described below.

GOOD :
This status indicates that the controller has completed a command normally.

CHECK CONDITION :

This status indicates that the command has been terminated abnormally due to an error that causes sense data to be loaded, exception, or abnormal condition.
The host must issue an untagged REQUEST SENSE command on receipt a CHECK CONDITION status. Valid sense data may not be reported on a tagged REQUEST SENSE command. After reporting a CHECK CONDITION status, the controller may report a BUSY status for the command from another host until the sense data is retrieved.
Therefore the host must always issue a REQUEST SENSE command for the CHECK CONDITION status.

BUSY :

This status indicates that the controller is busy. The controller reports this status when it cannot receive a command from any host computer.

INTERMEDIATE / GOOD :

This status indicates that each command in a series of linked commands (except the last command) has completed successfully.
If this status is not returned, the chain of linked commands is broken.

RESERVATION CONFLICT :

This status is reported when the host computer attempts to access a logical unit that has been reserved by another host computer. This status is not reported, however, during the execution of the Release command (the controller executes the Release command).

QUEUE FULL :

This status is reported when the controller can not accept any command from the host computer because command queue is full.

Note : This is not applicable when Tagged command queuing is not used.

3.4 SCSI BUS ERROR CONDITIONS

3.4.1 TARGET MODE ERROR CONDITIONS

Under several error conditions, the controller may change the phase to Bus Free without correctly terminating the command (i.e., No Disconnect nor Command Complete messages sent to the host computer). The controller then clears all information regarding the command, to the exception of Sense Data (if any), and does not attempt to reconnect to the host computer.
This host computer must consider this as a catastrophic error.
For the following descriptions, the Parity error is applied to this controller communicating on the bus that are configured with parity enabled.

(1) Message Out Phase parity Error

(2) Command Phase Parity Error

(3) Data Out Phase Parity Error

(4) Initiator Detected Error Message

(5) Rejected Message

(6) Initiator Message Parity Error

(7) Reselection Time-out

(8) Internal Controller Error

3.4.2 INITIATOR MODE ERROR CONDITION

This controller does not create the initiator mode error condition, since it does not support COPY, COMPARE and COPY AND VERIFY commands.

3.5 SPI Information Unit

This chapter describes the explanation abort SPI Information Unit.

3.5.1 SPI Command Information Unit

By SPI Command Information Unit, CDB, Task Attribute, and Task Management Flags are transmitted to a controller by the host.

It is a table about SPI command information unit. It is shown to Table 3.11

Table 3.11 SPI Command Information Unit

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							
	0	0	0	0	0	0	0	0
1	Reserved					Task Attribute		
	0	0	0	0	0			
2	Task Management Flags							
3	Additional CDB Length ((n-19)/4)						RDDATA	WRDATA
4 | 19	(MSB) CDB (LSB)							
20 | n	(MSB) Additional CDB (LSB)							
n+1 | n+4	(MSB) IUCRC (LSB)							

It is a table about the value and the contents which can be specified to be Task Attribute field by this controller. It is shown to Table 3.12.

Table 3.12 Task Attribute

Code	Description
000b	Simple Queue Task
001b	Head of Queue Task
010b	Ordered Queue Task
011b	Reserved
100b	ACA(Automatic Contingent Allegiance) Task(not support)
101b-111b	Reserved

The controller does not support ACA (Automatic Contingent Allegiance).

If a non supported task attribute or task attribute of reserve is specified to be Task Attribute of SPI Command Information Unit, the controller sets SPI COMMAND INFORMATION UNIT FIELD INVALID as Packetized Failure Code of SPI Status Information Unit.

The Task Management Function of current I_T_L_Q Nexus is specified to be the Task Management Flags field.
It is a table about the value and the contents which can be specified to be Task Management Flags field by this controller. It is shown to Table 3.13.

Table 3.13 Task Management Flags

Code	Description
00_H	Indicates no task management requests for the current task.
01_H	The task manager shall abort the task as defined in the ABORT TASK message.
02_H	The task manager shall abort the task set as defined in the ABORT TASK SET message.
04_H	The task manager shall clear the task set as defined in the CLEAR TASK SET message.
08_H	The task manager shall perform a logical unit reset of the selected logical unit as defined in the LOGICAL UNIT RESET message.(non support)
20_H	The task manager shall perform a target reset as defined in the TARGET RESET message.
40_H	The task manager shall perform a clear ACA as defined in the CLEAR ACA message.(non support)
Others	The task manager shall terminate the task with a GOOD status.The packetized failure code shall be set to TASK MANAGEMENT FUNCTION NOT SUPPORTED.

The controller does not support a LOGICAL UNIT RESET message and CLEAR ACA message.

When specified Task Management Function goes wrong, the controller sets GOOD as Status field of SPI Status Information Unit, and sets TASK MANAGEMENT FUNCTION FAILED as a setup and Packetized Failure Code.

The WRDATA(Write Data)bit and RDDATA(Read Data) bit are ignore by the controller.

The CDB field contains the actual CDB to be interpreted by the addressed logical unit. The CDB field and the Task Attribute field is not valid and is ignored if the Task Management Flags field is not zero. Any bytes between the end of a 6 byte CDB, 10 byte CDB, or 12 byte CDB and the end of the CDB field shall be reserved.

The Additional CDB field contains any CDB bytes beyond those contained within the standard 16b byte CDB field.

The CDB field, Additional CDB field, and Task Attribute field are not valid and are ignore if the Task Management Flags field is not zero.

The contents of the CDB and Additional CDB fields shall be as defined in the SCSI command standards.

IUCRC(Information Unit CRC) is specified to be IUCRC field.

3.5.2 SPI L_Q Information Unit

The SPI L_Q Information Unit(see Table 3.14) contains L_Q nexus information for the information unit that follows, the type of information unit that follows, and the length of information unit that follows. A SPI L_Q Information Unit shall precede all SPI Command Information Unit, SPI Multiple Command Information Unit, SPI Data Information Unit, SPI Status Information Unit, and the first of an uninterrupted sequence of SPI Data Stream Information Units.

Table 3.14 SPI L_Q Information Unit

Bit / Byte	7	6	5	4	3	2	1	0
0	TYPE							
1	Reserved							
	0	0	0	0	0	0	0	0
2 | 3	(MSB) Tag Number							(LSB)
4 | 11	(MSB) Logical Unit Number							(LSB)
12	Reserved							
	0	0	0	0	0	0	0	0
13 | 15	(MSB) Data Length							(LSB)
16	BIDI Direction		Reserved					
			0	0	0	0	0	0
17	Reserved							
	0	0	0	0	0	0	0	0
18 | 19	(MSB) IUCRC Interval							(LSB)
20 | 23	(MSB) IUCRC							(LSB)

TYPE field expresses the kind of SPI L_Q information unit.(see Table 3.15)

Table 3.15 TYPE

Code	Type	Description
01_H	Last Command	It is shown that SPI Command Information Unit follows and it is transmitted to the controller from the host. It is shown that two or more SPI Command Information Units are not transmitted. Set the value more than 000014_H and not more than 000090_H to Data Length field. Set 00b to BIDI Direction field. When set up expect 00b, the controller disregards a setup. Set 0000_H to IUCRC Interval field. When set up expect 0000_H, the controller disregards setting value.
02_H	Multiple Command	It is shown that SPI Command Information Unit follows and it is transmitted to the controller from the host. Set the value more than 000014_H and not more than 000090_H to Data Length field. Set 00b to BIDI Direction field. When set up expect 00b, the controller disregards a setup. Set 0000_H to IUCRC Interval field. When set up expect 0000_H, the controller disregards setting value.
04_H	Data	It is shown that SPI Data Information Unit follows and it is transmitted to the host from the controller. The value beyond 000000_H is shown in Data Length field. The data transmission direction is shown in BIDI Direction field.
05_H	Data Stream	It is shown that SPI Data Stream Information Unit follows, and it is transmitted to the host from the controller. The value beyond 000000_H is shown in Data Length field. The data transmission direction is shown in BIDI Direction field.
08_H	Status	When Data Length is except 000000_H, it is shown that SPI Status Information Unit follows and it is transmitted to the host from the controller. When Data Length is 000000_H, it is shown that SPI Status Information Unit does not follow and it is transmitted to the host from the controller. 00b is shown in BIDI Direction field. 0000_H are shown in IUCRC Interval field.
$F0_H$ - FF_H	-	Vendor Specific
Others	-	Reserved

field is an 16-bit integer assigned by the application client and sent to the

The Logical nit N field specifies the address of the logical unit of the I_T_L_Q nexus for the current task.

ata L field contains the length in bytes of the following I Unit. For SPI ata S Information nits the D Length field contains the Data tream I Unit that follows (i.e., the total number of bytes transferred would equal the data length times the number of Data tream I Units transferred).

IUCRC nor any transmitted pad bytes (e.g., a data length of 509 with a CRC interval of zero or greater than 509 would transfer 509 bytes of data plus 3 bytes of pad plus 4 bytes of IU a total transfer of 516 bytes).
that exceeds the maximum burst size as defined in the

The BIDI Direction
bidirectional command and the
for the BIDI Direction Table .16

Table 3.16 BIDI Direction

Code	Description
00b	A unidirectional command or a type code other than data or data stream
01b	A bidirectional command transferring data from the host to the controller.(Write)
10b	A bidirectional command transferring data from the controller to the host.(Read)
11b	Reserved

The IUCRC Interval field contains the length in bytes of the data to be sent before a IUCRC is transferred. The IUCRC interval length shall not include the 4 byte IUCRC nor any transmitted pad bytes (e.g., an IUCRC interval length of 510 transfer 510 bytes of data plus 2 bytes of pad plus 4 bytes of IUCRC for a total transfer of 516 bytes). The IUCRC interval shall be a multiple of two (i.e., odd numbers are not allowed). If the IUCRC interval is equal to zero or is greater than or equal to the data length only one IUCRC shall occur at the end of the SPI Information Unit.

IUCRC(Information Unit CRC) is specified to be IUCRC field.

3.5.3 SPI Data Information Unit

The SPI data information unit (see Table 3.17) contains data.

The detection of a BUS FREE phase following a SPI data information unit by an initiator shall be equivalent to the initiator receiving a DISCONNECT message.

The detection of a QAS REQUEST message following a SPI data information unit by an initiator shall be equivalent to the initiator receiving a DISCONNECT message.

Table 3.17 SPI Data Information Unit

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)							
|				Data				
n								(LSB)
n+1	(MSB)							
|				IUCRC				
n+4								(LSB)

The Data field may contain any type of information (e.g., parameter lists, mode pages, user data, etc.).

IUCRC(Information Unit CRC) is specified to be IUCRC field.

3.5.4 SPI Data Stream Information Unit

The SPI data stream information unit (see Table 3.18) contains data.

All the SPI data stream information units transferred after a SPI L_Q information unit with a type of data stream shall be the size indicated in the DATA LENGTH field of the SPI L_Q information unit.

If the data transfer size is not a multiple of the data length, the target shall end the stream at a data length boundary and shall send a new SPI L_Q with a smaller data length to finish the data transfer. The new SPI L_Q may or may not be sent during the current physical connection.

Table 3.18 SPI Data Stream Information Unit

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)							
|				Data				
n								(LSB)
n+1	(MSB)							
|				IUCRC				
n+4								(LSB)

The DATA field may contain any type of information (e.g., parameter lists, mode pages, user data, etc.).

IUCRC(Information Unit CRC) is specified to be IUCRC field.

3.5.5 SPI Status Information Unit

The SPI status information unit (see Table 3.19) contains the completion status of the task indicated by the preceding SPI L_Q information unit. The target shall consider the SPI status information unit transmission to be successful when there is no attention condition on the transfer of the information unit.

If a task completes with a GOOD status, a SNSVALID bit of zero, and a RSPVALID bit of zero then the target shall set the DATA LENGTH field in the SPI L_Q Information Unit (see 3.5.2) to zero.

Table 3.19 SPI Status Information Unit

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							
	0	0	0	0	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	Reserved						SNS Valid	RSP Valid
	0	0	0	0	0	0		
3	Status							
4 | 7	(MSB) Sense Data List Length(n-m) (LSB)							
8 | 11	(MSB) Packetized Failures List Length(m-11) (LSB)							
12 | m	(MSB) Packetized Failures (LSB)							
m+1 | n	(MSB) Sense Data (LSB)							
n+1 | n+4	(MSB) IUCRC (LSB)							

A SNS Valid (Sense Data Valid) bit of zero indicates the sense data list length shall be ignored and no sense data is provided. A SNS Valid bit of one indicates the Sense Data List Length field specifies the number of bytes in the Sense Data field. If the STATUS field contains a CHECK CONDITION status the SNS Valid bit shall be set to one.

If sense data is provided, the SNS Valid bit shall be set to one and the Sense Data List Length field shall specify the number of bytes in the Sense Data field. The Sense Data List Length field shall only contain even lengths greater than zero and shall not be set to a value greater than 252.

If no sense data is provided, the SNS Valid bit shall be set to zero. The host shall ignore the Sense Data List Length field and shall assume a length of zero.

If packetized failure data is provided, the RSP Valid (Packetized Failures Valid) bit shall be set to one and the Packetized Failures List Length field shall specify

the number of bytes in the Packetized ailures field. The Packetized ailures L Length
standardization.

If no packetized failure data is provided, the bit shall be set to zero. The initiator shall ignore the P Failures ist L field and shall assume a length of zero.

tatus field contains the status of a task that completes. See STATUS for a list of status codes.

the packetized failures
FAILURES field shall contain valid information if the
conditions described by the packetized failure code (see Table .20

Table 3 20 Packetized Failure field

Byte	7		5	4		2	1	
0	Reserved							
		0	0		0	0		0
1								
	0	0		0	0		0	0
	Reserved							
	0		0	0		0	0	
3	Packetized Failure Code							

acketized F field is defined in Table .21

Table 3 21 Packetized Failure Code

	Description
00	NO FAILURE or TASK MANAGEMENT FUNCTION COMPLETE.
01	Reserved
02	SPI COMMAND INFORMATION UNIT FIELDS INVALID
03	Reserved
04	TASK MANAGEMENT FUNCTION NOT SUPPORTED
05	TASK MANAGEMENT FUNCTION FAILED
06	INVALID TYPE CODE RECEIVED IN SPI L_Q INFORMATION UNIT
H	ILLEGAL REQUEST RECEIVED IN SPI L_Q INFORMATION UNIT
H -FF	Reserved

4 SCSI COMMANDS

The SCSI commands are defined as the data structure viewed through the SCSI interface.

A single command may transfer one or more logical blocks of data.
The controller may disconnect from the SCSI bus while making preparations for data transfer to make the SCSI bus available to other SCSI devices.

Whenever a command is completed (normally or abnormally), the controller returns the status byte to the host computer.

4.1 COMMAND STRUCTURE

A request to the controller is generated by the host computer sending a command descriptor block (CDB). For some commands, the request is accompanied by a Parameter List that are transferred in the Data Out phase to give a detailed definition of the request.

The CDB consists of the operation code, the logical unit number, the command parameters and the control byte. Its length varies depending on the value of the group code in the operation code.

If an invalid parameter is found in the CDB, the controller terminates the command without accessing the disk medium.

In the rest of this section, only the items that are common to the SCSI commands are described. Specifications that are unique to the individual commands are found in Chapter 5.

Table 4.1 shows the format of the standard CDB (for 6-byte commands), Table 4.2 shows that of the standard CDB (for 10-byte commands) and Table 4.3 shows that of the standard CDB (for 12-byte commands).

Table .1

Byte \ Bit		6	5		3	2		0
0	Operation Code							
1	Logical Unit Number			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Transfer Length							
5	Control Byte							

Table 4.2 Standard Command Descriptor Block for 10-byte Commands

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved				RelAdr
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Control Byte							

Table 4 3 Standard Command Descriptor Block for 12-byte Commands

Byte \	7		5	4		2	1	
0	Operation Code							
1	Logical Unit Number			Reserved				RelAdr
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Transfer Length (MSB)							
7	Transfer Length							
8	Transfer Length							
9	Transfer Length (LSB)							
10	Reserved							
11	Control Byte							

4.1.1 OPERATION CODE

Table 4.4 shows the format of the operation code.

Table 4.4 Operation Code

Bit / Byte	7	6	5	4	3	2	1	0
0	Group Code			Command Code				

The Operation Code consists of the group code and the command code.

This controller supports group 0 (6-byte commands) and group 1 and 2 (10-byte

receives an unsupported or undefined command, it creates the CHECK CONDITION status with ILLEGAL REQUEST sense key. See Chapter 5 for the

4.1.2

The Logical Unit Number (LUN) identifies a logical unit attached to the controller. The controller supports a LUN of 0.

(except the INQUIRY and REQUEST SENSE commands) with a CHECK

controller ignores this field when it received an IDENTIFY message.

RELATIVE ADDRESS

4.1.4

The Logical Block Address on a logical unit begins with block 0 and is contiguous up to the last logical block on that logical unit.

5 CDBs contain a 32-bit Logical Block Address area.

If a logical block address beyond the logical block address (this address is reported

block on a logical unit is specified, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

(explained later) to access a block beyond the last block on the logical unit, the controller specifies the address as an invalid logical block address and creates the

The number of data bytes per logical block is reported to the host computer through the READ CAPACITY or MODE SENSE command.

4.1.5 TRANSFER LENGTH

The Transfer Length specifies the amount of data to be transferred (normally in logical blocks).

In some commands, the transfer length represents the number of requested bytes as explained in their command descriptions.
In such cases, this field is referred to as the byte transfer length field.

Commands (6-byte commands) that allocates one byte to the transfer length field can transfer a maximum of 256 blocks of data. Transfer lengths of 1 to 255 represent the number of blocks to be transferred and transfer length of 0 represents 256 blocks.

Commands (10-byte commands) that allocates two bytes to the transfer length field can transfer a maximum of 65, 535 blocks of data. A transfer length of 0 indicates that no block is to be transferred.
Transfer lengths of 1 to 65, 535 represent the number of blocks to be transferred.

Commands (12-byte commands) that allocates four bytes to the transfer length field can transfer a maximum of 4,294,967,295 blocks of data. A transfer length of 0 indicates that no block is to be transferred.
Transfer lengths of 1 to 4,294,967,295 represent the number of blocks to be transferred.

The transfer length of commands that transfer a parameter list to the controller is called the parameter list length. The parameter list length is used to specify the number of bytes to be transferred during the Data Out phase.

The transfer length of commands that return sense data to the host computer (e.g., REQUEST SENSE, INQUIRY, and MODE SENSE commands) is called the Allocation Length. The allocation length is used to specify the number of bytes that are allocated by the host computer for the data to be transferred.

The controller terminates the Data In phase when the number of bytes specified in the Allocation Length field have been transferred or when all available sense data have been transferred to the host computer, whichever is less.

4.1.6 CONTROL BYTE

The control byte is the last byte of the CDB.

Table 4.5 Control Byte Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Vendor Unique		Reserved				Flag	Link

The host computer should set the Vendor Unique bits of control byte to 0 since these bits for certain commands may be used to test the drive during the manufacturing process.

If the Link bit is set to 1, and if the command terminates successfully, the controller sends the following message to the host computer according to Flag bit.

Flag bit = 0 --- LINKED COMMAND COMPLETE
Flag bit = 1 --- LINKED COMMAND COMPLETE (WITH FLAG)

If the command terminates abnormally, regardless of Flag bit, the controller sends COMMAND COMPLETE message.
If the Link bit is set to 0, the host computer shall set Flag bit to 0. If it is violated, the controller returns CHECK CONDITION status with ILLEGAL REQUEST sense key.
If the Link bit is set to 1, and if the command terminates successfully, the controller returns INTERMEDIATE status and then sends one of above messages to the host computer according to Flag bit.
The controller immediately goes to COMMAND phase from MESSAGE IN phase.

4.1.7 RESERVED

The host computer must set any reserved bits, fields, or bytes of the CDB and parameter list to 0. If this condition is violated, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

4.1.8 VENDOR UNIQUE

The host computer must set any vendor unique bits, fields, or bytes of the CDB

(normally to 0). The controller checks the vendor unique bits, fields, or bytes. If this condition is violated, the controller will create the CHECK CONDITION

5 COMMAND DESCRIPTIONS

5.1 FORMAT UNIT:(04_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (04_H)							
	0	0	0	0	0	1	0	0
1	Logical Unit Number			FmtData	CmpLst	Defect List Format		
2	Certification Pattern							
3	Interleave (MSB)							
4	Interleave (LSB)							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The FORMAT UNIT command formats the medium so that all of the addressable data blocks can be accessed by the host. Any existing data on the medium is lost after the FORMAT UNIT command is initiated by the controller.

The controller formats the media in accordance with the current value of MODE SELECT parameter (see 5.5 MODE SELECT) established and the media defect management schemes specified from the host computer by this command.

It is recommended that the MODE SELECT parameters should be set properly prior to the issuance of FORMAT UNIT command.
A FORMAT UNIT command must be sent if the block length or the number of alternate spare areas are changed.

If FORMAT UNIT command is completed abnormally after formatting is started, the command accesses to medium after FORMAT UNIT command is terminated with CHECK CONDITION status, then the controller sets the sense key to NOT READY with the additional sense code of FORMAT COMMAND FAILED.

There are four defect management schemes, namely, P, C, D and G.

< P = Primary Defect List >
This list refers to the list of defects that are considered as permanent flaws.
This list is recorded in a specific location on the device by the manufacturer of the device.

< C = Target Certification >
Includes defects that are detected by the controller during an optional verify process executed during the FORMAT UNIT command. The controller includes the list into the G list and records it in a specific location on the device.

< D = Data Defect List >
This list is supplied to the controller by the host computer in the Data Out phase of the FORMAT UNIT or REASSIGN BLOCKS command (see 5.15, “Reassign Blocks”). The controller includes the list into the G list and records it in a specific location on the device.
The host needs to specify the defect of user area within the limits.

< G = Grown Defect List>
This list includes the defects from the C and D lists that are added as the result of the normal termination of the proceeding FORMAT UNIT or REASSIGN BLOCKS command. This list is distinguished from the P list and its defects are classified as grown after the manufacture of the medium.

The FmtData (Format Data) bit = 1 indicates that the defect list header and defect data (defect descriptors) are transferred from the host computer during the Data Out phase of the command.
The format of the defect data is determined by the Defect List Format field in bits 0-2.
The FmtData bit = 0 indicates that the Data Out phase must not occur, that is, neither defect list header nor defect data must be supplied from the host computer. The controller executes the formatting with the default mode of the controller and CmpLst must be set to 0.

Note : The default mode is DPRY, DCRT, STPF, IP and DSP set to 0. (These function are explained in the Defect List Header section.)

The CmpLst (Complete List) bit = 1 indicates that the data supplied by the host computer during the Data Out phase of this command is the complete list of known defects. The controller deletes the old G list and creates a new list.
The CmpLst bit = 0 indicates that the data supplied by the host computer during the Data Out phase of the command is to be added to the existing defect data.

Note : If FmtData bit is set to 0, CmpLst bit is ignored.
The controller uses the default value (CmpLst bit off).

The Defect List format field specifies additional information related to the defect list (see Table 5.1 for further information).

The Certification Pattern field specifies the data pattern to be written in data blocks.

FORMAT UNIT:(04h)

The Interleave field requests that the logical blocks are related in a specific manner to physical blocks to facilitate speed matching between the host bus data transfer rate and the block data transfer rate of the device.
This controller supports the Interleave value one only but ignores the Interleave field.

The host computer can specify the format for the defect management schemes and defect list according to the definition of CDB byte 1, bits 0-4, as summarized in Table 5.1.

Table 5.1 Format Unit Command Variations

4 Fmt Data	3 Cmp Lst	2	1	0 Defect List Format	Defect List Length	Defect Management	Defect List Format
0	X	X	X	X	-	P + C + G	-
1	0	0	X	X	=0	(P) + (C) + G	-
1	1	0	X	X	=0	(P) + (C)	-
1	0	0	X	X	>0	(P) + (C) + D + G	Block (Note 3)
1	1	0	X	X	>0	(P) + (C) + D	
1	0	1	0	0	>0 or =0	(P) + (C) + D + G	Byte from index format
1	1	1	0	0	>0 or =0	(P) + (C) + D	
1	0	1	0	1	>0 or =0	(P) + (C) + D + G	Physical sector
1	1	1	0	1	>0 or =0	(P) + (C) + D	

Note 1 : X denotes a don't care condition.
Note 2 : Defect management schemes enclosed in parentheses depend on the defect list header specification.
Note 3 : When CmpLst bit = 0, the defect list data needs to be transferred in the format of logical block address.
when CmpLst bit = 1. the defect list data needs to be transferred in the format of physical block address. Physical block address is defined as sequential number, starting from zero, of physical sectors which locate in the user cylinder area.

The controller allocates alternate sectors for defect blocks according to the specified defect management scheme.

The defect list comprises the defect list header shown Table 5.2 followed by defect descriptors (see Table 5.3, Table 5.4 and Table 5.5).

FORMAT UNIT:(04h)

Table 5.2 Defect List Header

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved 0	0	0	0	0	0	0	0
1	FOV	DPRY	DCRT	STPF	IP	DSP	Immed	VU 0
2	Defect List Length (MSB)							
3	Defect List Length (LSB)							

The host computer can control the following format processing by defining byte 1, bits 2-7 of the defect list header.

Bit 7 : The FOV (Format Options Valid) bit, when set to 0, specifies that the default values of the controller are used for the functions defined in bits 2-6.
The default values of the controller are all zeros for bits 2 through 6. When the FOV bit is set to 0, the host computer must set bits 2 through 6 to all zeros.
If this conditions is violated, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.
When the FOV bit is specified to 1, the controller is to take action as specified by the host computer in bits 2-6.

Bit 6 : The DPRY (Disable Primary) bit, when set to 0, specifies that the controller is to format the medium using the primary defect list. When this bit is set to 1, the controller does not use the primary defect list.

Bit 5 : The DCRT (Disable Certification) bit, when set to 0, specifies that the controller executes target certification (verify) processing during formatting. When this bit is set to 1, the controller suppresses target certification processing.

FORMAT UNIT:(04h)

Bit 4 : The STPF (Stop Format) bit, when set to 0, specifies that the controller is to execute the formatting even if an unrecoverable error occurs while accessing either list of defects P or G recorded on the device. In this case, if no error occurred except during the access to the defect list, the controller creates the CHECK CONDITION status with RECOVERED ERROR sense key after completion of the format process.
When the STPF bit is set to 1 and an unrecoverable error occurs during the access to the defect list, the controller stops the format process and terminates the command with a CHECK CONDITION status and set the sense key to "MEDIUM ERROR".

Bit 3 : The IP (Initialization Pattern) bit of 1 indicates that initialization pattern descriptor is included in the Format Unit parameter list immediately following the defect list header and is used to initialize the data blocks. An IP bit of 0 indicates that an initialization pattern descriptor is not included and the controller shall use the certification pattern in the command descriptor block for the data block initialization.

Bit 2 : The DSP (Disable Saving Parameters) bit, when set to 1, specifies that the controller shall not save the MODE SELECT savable parameters to non-volatile memory during the format operation.
A DSP bit of 0 specifies that the controller shall save all the MODE SELECT savable parameters for all initiators to non-volatile memory after the format process completed normally.

Bit 1 : If the Immed (Immediate) bit is set to 0, a status is not returned until the actual completion of the command.
If the Immed (Immediate) bit is set to 1, a status is returned as soon as the command descriptor block has been validated, and the entire defect list has been transferred.

The defect list length specifies the total length in bytes of the subsequent defect descriptors following either the defect list header (if IP bit = 0) or the initialization pattern descriptor. This value may be zero. In this case, no defect descriptor is transferred from the host computer.

The defect list length value must be four times the number of defect descriptors for the block format (Table 5.3) and eight times the number of defect descriptors for the byte from index format (Table 5.4) or the physical sector format (Table 5.5).

FORMAT UNIT:(04h)

When no 4-byte header is transferred or when an invalid defect list length is specified, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

Table 5.3 Defect List --- Block Format

Byte	Defect Descriptor (s)
0	Defect Block Address (MSB)
1	Defect Block Address
2	Defect Block Address
3	Defect Block Address (LSB)

Each defect descriptor specifies the 4-byte defect block address of the block containing a defect.

If a block address exceeding the maximum address allowed for the drive is specified, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

When the CmpLst bit (CDB byte 1, bit 3) is set to 0, the defect block address specifies the logical block address related to block length of the block that is currently being formatted.
When the CmpLst bit is set to 1, the defect block address specifies the physical block address related to the new block length.

Table 5.4 Defect List --- Byte from Index Format

Byte	Defect Descriptor (s)
0	Cylinder Number of Defect (MSB)
1	Cylinder Number of Defect
2	Cylinder Number of Defect (LSB)
3	Head Number of Defect
4	Defect Bytes from Index (MSB)
5	Defect Bytes from Index
6	Defect Bytes from Index
7	Defect Bytes from Index (LSB)

Each defect descriptor specifies the Cylinder Number, Head Number and Bytes from Index. The host computer must send the defect descriptors in the ascending order of address. The most significant address is the Cylinder Number and the least one is the Bytes from Index.
It is not possible to specify the value of $FFFFFFFF_H$ (as a bad track) to the Defect Bytes from Index field.

FORMAT UNIT:(04h)

If the defect location is identified as invalid or the defect descriptors are not in the ascending order of address, the controller returns CHECK CONDITION status with ILLEGAL REQUEST sense key.

Note 1 : When the G list is read by the READ DEFECT DATA command, the obtained Defect Bytes from Index value appears with respect to only the first defect in the same sector.

Table 5.5 Defect List --- Physical Sector Format

Byte	Defect Descriptor (s)
0	Cylinder Number of Defect (MSB)
1	Cylinder Number of Defect
2	Cylinder Number of Defect (LSB)
3	Head Number of Defect
4	Defect Sector Number (MSB)
5	Defect Sector Number
6	Defect Sector Number
7	Defect Sector Number (LSB)

Each defect descriptor specifies the Cylinder Number, Head Number and Sector Number. The host computer must send the defect descriptors in the ascending order of address. The most significant address is the Cylinder Number and the least one is the Sector Number field.

It is not possible to specify the value of $FFFFFFFF_H$ (as a bad track) to the Defect Sector Number field.

If the defect location is identified as invalid or the defect descriptors are not in the ascending order of address, the controller returns CHECK CONDITION status with ILLEGAL REQUEST sense key.

Table 5.6 Initialization Pattern Descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	IP Modifier		Reserved 0	0	0	0	0	0
1	Pattern Type							
2	Initialization Pattern Length (MSB)							
3	Initialization Pattern Length (LSB)							

(cont'd)

Table 5.6 Initialization Pattern Descriptor (cont'd)

Initialization Pattern	
0	Pattern
|	|
n	Pattern

When the IP bit (Byte 1, Bit 3 in Defect List Header) is set to 1, the Initialization pattern Descriptor is transferred immediately after the Defect List Header.
The IP Modifier field is used to specify the initialization pattern as follows.

Table 5.7 IP Modifier

Bit 7	Bit 6	Description
0	0	No modification made to the initialization pattern.
0	1	The controller writes the logical block address in the first four bytes of the first sector out of the logical block.
1	0	The controller writes the logical block address in the first four bytes of each sector in the logical block.
1	1	Reserved

The Pattern Type field specifies the pattern type to be used for writing the data field of the logical blocks which are accessible by the host, as follows.

00_H - - - - - - - - The data pattern specified in the Certification Pattern field of the command descriptor block is used.

01_H - - - - - - - - The data pattern specified in the Initialization pattern field is used.

02_H - FF_H - - - - Reserved.

FORMAT UNIT:(04h)

The Initialization pattern Length field specifies the following Initialization Pattern length in bytes. The available value to specifies is n (= 0 to bytes/sector).

00_H - - - - - - - - The data pattern specified the Certification Pattern field of the command descriptor block is used.

n_H - - - - - - - - Specifying the pattern length that follows.

The Pattern field specifies the writing data pattern in the data field. This field contains the data bytes and it is used repeatedly for the writing.

FORMAT UNIT:(04h)

5.2 INQUIRY:(12_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (12_H)							
	0	0	0	1	0	0	1	0
1	Logical Unit Number			Reserved				EVPD
				0	0	0	0	
2	Page Code							
3	Reserved							
	0	0	0	0	0	0	0	0
4	Allocation Length							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The INQUIRY command transfers the parameter information regarding the controller to the host computer.

The EVPD (Enable Vital Product Data) bit of 0 indicates that Standard Inquiry Data is transferred from the controller to the host computer. In this case, the Page Code field must be set to 00_H. Otherwise, the controller reports the CHECK CONDITION with ILLEGAL REQUEST sense key.

The EVPD bit of 1 indicates that the controller transfers Vital Product Data as specified in the Page Code field.
The Page Code specifies a page of Vital Product Data to be transferred to the host computer. Supported Pages of Vital Product Data are as follows :

Page Code	Description
00_H	Supported Vital Product Data
80_H	Unit Serial umber
81_H	Implemented Operating Definition
83_H	Device Identification
$C0_H$	Jumper Information

When any page code other than above is specified, the controller returns the CHECK CONDITION with ILLEGAL REQUEST sense key.

The allocation length specifies the number of bytes that are allocated by the host computer for the data to be transferred.

No data is transferred if the Allocation Length is set to 0. This condition, however, is not considered as an error. Other allocation length values specify the maximum number of bytes to be transferred. The controller terminates the Data In phase when the number of bytes specified in the Allocation Length field have been transferred or when all available inquiry data have been transferred to the host computer, whichever is less.

The controller reports the CHECK CONDITION status only when it cannot transfer the requested inquiry data. The controller does not report the CHECK CONDITION status for the INQUIRY command even if the UNIT ATTENTION status is held pending.
And the Unit Attention status is not cleared by INQUIRY command.

The Standard Inquiry Data is shown in Table 5.8 and the Vital Product Data are shown in Table 5.10 (Supported Vital Product Data) and Table 5.11 (Unit Serial Number).

Table 5.8 Standard Inquiry Data

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Device Type Modifier						
	0	0	0	0	0	0	0	0
2	ISO Version		ECMA Version			ANSI Version		
	0	0	0	0	0	0	1	1
3	AENC	Trm IOP	Reserved		Response Data Format			
	0	0	0	0	0	0	1	0
4	Additional Length ($6B_H$)							
	0	1	1	0	1	0	1	1
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							Addr16
	0	0	0	0	0	0	0	
7	RelAdr	WBus32	Wbus16	SYNC	Linked	TranDis	CmdQue	SftRe
	0	0		1	1	1	1	0
8-15	Vendor Identification (in ASCII) “HITACHI€”							
16-31	Product Identification (in ASCII)							
32-35	Product Revision Level (in ASCII)							

(cont’d)

INQUIRY:(12h)

Table 5.8 Standard Inquiry Data (cont'd)

Product Information								
36-43	Product Serial Number							
44-51	Reserved 0	0	0	0	0	0	0	0
Drive Jumper Information								
52	ID Jumper							
53	Vendor Unique				Auto Start	Delay Start	Vendor Unique	
54	Vendor Unique							
55	Vendor Unique							Write Protect
56	Reserved 0	0	0	0	Clocking		QAS 1	IUS 1
57-95	Reserved 0	0	0	0	0	0	0	0
96-143	Copyright (in ASCII) "Copyright (C) 2002 Hitachi All right reserved"							

Note : € denotes a space character (code 20_H).

The Standard Inquiry Data (Table 5.8) consists of a 5-byte header, followed by 139 bytes of additional parameters.

When the LUN is 0, the Peripheral Qualifier field is loaded with code 0_H and indicates that the specified device type is currently connected.

The Peripheral Device Type field is loaded with code 0_H and identifies a direct access device. If LUN of 1 or more is specified, it is loaded with code $7F_H$ (Qualifier = 3_H, Device Type = $1F_H$), indicating that specified logical unit is not present (Logical Unit not Present).

The RMB (Removable) bit is always set to 0 and indicates that the medium cannot be removed.

The Device Type Modifier field is loaded with 0_H and identifies the controller does not use this field.

The ISO Version (International Standard Organization Version) field is loaded with code 0_H and indicates that the controller does not conform with the ISO version specification.

The ECMA Version (European Computer Manufacture Association Version) field is loaded with code 0_H and indicates that the controller does not conform with the ECMA Version specification.

The ANSI Version field is loaded with code 3_H and indicates that the controller conforms with the SCSI-2 version.

The AENC (Asynchronous Event Notification Capability) bit is set to 0 and indicates that the controller does not support the asynchronous event notification function.

The Trm IOP (Terminate I/O Process) bit is set to 0 and indicates that the controller does not support the TERMINATE I/O PROCESS message.

The Response Data Format field is loaded with code 2_H and indicates that the controller conforms with the ANSI SCSI-2 specifications.

The Additional Length field is loaded with code $6B_H$ and indicates that the additional parameters is consisted of 107 bytes. This field holds the same value, irrespective of the allocation length stored in the CDB.

The Addr16(Wide SCSI Address 16) bit of 0 indicates that the controller does not support the 16-bit wide SCSI address. The Addr16 bit of 1 indicates that the controller supports the 16-bit wide SCSI address.

The RelAdr (Relative Address) bit is set to 0 and indicates that the controller does not support the relative address capability.

The WBus 32 (Wide Bus 32) bit is set to 0 and indicates that the controller does not support the 32 bits width data transfer.

The WBus 16 (Wide Bus 16) bit of 0 indicates that the controller does not support the 16 bits width data transfer. The WBus 16 bit of 1 indicates that the controller supports the 16 bits width data transfer.

The Sync (Synchronous Transfer) bit is set to 1 and indicates that the controller supports the synchronous data transfer.

The Linked (Linked Command) bit is set to 1 and indicates that the controller supports the linked command capability.

INQUIRY:(12h)

The TranDis (Transfer Disable) bit of 0 indicates that the controller does not support the CONTINUE I/O PROCESS and TARGET TRANSFER DISABLE message. The TranDis bit of 1 indicates that the controller supports the CONTINUE I/O PROCESS and TARGET TRANSFER DISABLE message.

The CmdQue bit of 1 indicates that the controller supports the tagged command queuing.

The SftRe (Soft Reset) bit is set to 0 and indicates that the controller only uses the Hard Reset.

The vendor identification field contains "HITACHI" in ASCII code.
The product identification field contains the product name in ASCII code .
The Product Revision Level field contains the revision number of the controller firmware in ASCII code. When the drive is not ready state, it indicates only the ROM program revision, while the drive is ready it indicates the ROM and RAM program revision.

< Drive Jumper Information fields >
The Drive Jumper Information fields indicate the jumper pins installed on the drive PCB.
Refer to the Product Specification for the specification of the jumpers.

< Product Information fields >
The Product Serial Number field indicates the drive serial number with 8 digits.

The Clocking field indicates shall not apply to asynchronous transfers and is defined in Table 5.9.

Table 5.9 Clocking

Code	Description
00b	Indicates the controller supports only ST(Single Transition)
01b	Indicates the controller supports only DT(Double Transition)
10b	Reserved
11b	Indicates the controller supports ST and DT

The QAS (Quick Arbitrate Supported) bit is set to 1 and indicates that the controller does support the Quick Arbitrate.

The IUS (Information Unit Supported) bit is set 1 and indicates that the controller does support the Information Unit.

INQUIRY:(12h)

The Copyright field contains "Copyright (C) 2002 Hitachi All right reserved" in ASCII code.

Note : The ASCII data fields are loaded with data starting at their first byte position. Any remaining byte positions are padded with space characters (code 20_H).

[Page Code:00_H(EVPD=1)]

Table 5.10 Supported Vital Product Data

Byte \ Bit	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code(00_H)							
	0	0	0	0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Page Length(06_H)							
	0	0	0	0	0	1	1	0
Supported Page List								
4	00_H							
5	80_H							
6	81_H							
7	83_H							
8	$C0_H$							
9	Reserved (00_H)							

The Peripheral Qualifier and Peripheral Device Type are returned as described in the explanation following the Table 5.8 (Standard Inquiry Data).

The Page Code of 00_H indicates that this is the Supported Vital Product Data page.

The Page Length indicates the data length in bytes of Supported Page List.

The Supported Page List indicates the pages supported by the controller in the ascending order of their codes.

[Page Code:80_H(EVPD=1)]

Table 5.11 Unit Serial Number

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (80_H)							
	1	0	0	0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Page Length (14_H)							
	0	0	0	1	0	1	0	0
4 to 11	Product Serial Number							
12 to 23	Card Serial Number							

The Peripheral Qualifier and Peripheral Device Type are returned as described in the explanation following the Table 5.8 (Standard Inquiry Data).

The Page Code of 80_H indicates that this page indicates the unit serial number.

The Page Length indicates the data length in bytes of Product Serial Number(8 bytes) and Card Serial Number (12 bytes).

The Product Serial Number indicates the drive serial number with 8 digits.

The Card Serial Number indicates the card serial number with 12 digits.

[Page Code:81_H(EVPD=1)]

Table 5.12 Implemented Operating Definition Page

Byte \ Bit	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (81_H)							
	1	0	0	0	0	0	0	1
2	Reserved							
	0	0	0	0	0	0	0	0
3	Page Length (04_H)							
	0	0	0	0	0	1	0	0
4	RSV 0	Current Operating Definition						
5	SavImp 1	Default Operating Definition						
Supported Operating Definition List								
6	SavImp 1	01_H						
7	SavImp 1	03_H						

The Peripheral Qualifier and Peripheral Device Type are returned as described in the explanation following the Table 5.8 (Standard Inquiry Data).

The Page Code of 81_H indicates that this page indicates the implemented operating definition page.

The Page Length indicates the data length of the following operating definition.

The SavImp (Associated Save Implemented) bit of 0 indicates that the corresponding operating definition parameter cannot be saved.

The SavImp bit of 1 indicates that the corresponding operating definition parameter can be saved.

The Current Operating Definition field indicates the present operating definition the controller uses.
The Default Operating Definition field indicates the default operating definition the controller uses.
The Supported Operating Definition List field indicates the operating definition the controller supports.

INQUIRY:(12h)

Each operating definition is defined in Table 5.13.
The host computer , however , cannot change the operating definition since this controller does not support CHANGE DEFINITION command.

Table 5.13 Operating Definition

Operating definition value	Operating definition
00_H	Current
01_H	SCSI-1
02_H	CCS
03_H	SCSI-2
04_H	SCSI-3
05_H - $7F_H$	Reserved

[Page Code:83_H(EVPD=1)]

Table 5.14 Device Identification Page

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (83_H)							
	1	0	0	0	0	0	1	1
2	Reserved							
	0	0	0	0	0	0	0	0
3	Page Length (24_H)							
	0	0	1	0	0	1	0	0
Identification Descriptor List								
4	Reserved				Code Set			
	0	0	0	0	0	0	1	0
5	Reserved		Association		Identifier Type			
	0	0	0	0	0	0	0	1
6	Reserved							
	0	0	0	0	0	0	0	0
7	Identifier Length (20_H)							
	0	0	1	0	0	0	0	0
8 - 15	Vendor Identification (in ASCII) “HITACHI€”							
16 - 31	Product Identification (in ASCII)							
32 - 39	Product Serial Number							

INQUIRY:(12h)

The Peripheral Qualifier and Peripheral Device Type are returned as described in the explanation following the Table 5.8(Standard Inquiry Data).

The Page Code 83_H indicates that this page indicates the device identification page.

The Page Length indicates the data length in bytes of the Identification Descriptor List.

The Code Set "02_H " indicates that the Identification Descriptor List is set in a ASCII Code.

The Association "00b" indicates that the controller is physical device or logical device.

The Identifier Type "01_H " indicates that the T10 vendor identification.

The Identifier Length indicates the that the length in bytes of identifier field.

The vendor identification field contains "HITACHI" in ASCII code.

The product identification field contains the product name in ASCII code.

The Product Serial Number indicates the drive serial number with 8 digits.

[Page Code:$C0_H$(EVPD=1)]

Table 5.15 Jumper Information Page

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code ($C0_H$)							
	1	1	0	0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Page Length							
	0	0	0	1	0	1	0	0
Drive Firmware/Hardware Information								
4	Firmware/Hardware Information							

(cont'd)

INQUIRY:(12h)

Table 5.15 Jumper Information Page(cont'd)

16								
Drive Jumper Information								
17						Code Set		
	0			0	0		0	0
18	Reserved							
		0	0		0	0		0
19								
	0	0		0	0		0	0
	ID Jumper							
21					Auto Start	Delay Start		
22	Vendor Unique							
	Vendor Unique							Write

The Peripheral Qualifier and Peripheral Device Type are returned as described in the explanation following the 5. (Standard Inquiry Data).

The Page Code C0 indicates that this page indicates the jumper information page.

The Page Length indicates the data length in bytes of the following jumper

The Drive Firmware/Hardware Information indicates the drive revision level.

The Drive Jumper Information indicates the jumper pins installed on the drive PCB.

The Code Set "01_H" indicates that the Drive Jumper Information is set in a binary

The Data Length indicates the following Drive jumper information length in bytes.

INQUIRY:(12h)

5.3 LOG SELECT:($4C_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($4C_H$)							
	0	1	0	0	1	1	0	0
1	Logical Unit Number			Reserved			PCR	SP
				0	0	0		
2	PC		Reserved					
			0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Parameter List Length (MSB)							
8	Parameter List Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The LOG SELECT command provides a means for the initiator to manage statistical information supported by the drive. The command descriptor block of LOG SELECT provides for sending zero or more log pages during a DATA OUT phase.

The initiator can reset all the implemented log parameters to the drive-defined default values by setting the PCR (parameter code reset) bit to one and the parameter list length to zero. If PCR bit is one and the parameter list length is greater than zero, the LOG SELECT command will be terminated with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST and the sense code will be INVALID FIELD IN CDB. Table 5.16 shows all the setting conditions.

Table 5.16 PCR and Parameter List Length Fields

PCR	Parameter List Length	Controller's Action
1	Equal to 0	Reset all the implemented log parameters to drive-defined default values
1	Greater than 0	Terminates with CHECK CONDITION status
0	Don't care	Log parameters will not be reset

A save parameter (SP) bit of one directs the drive to save all log parameters to the disk which are identified as savable by the DS (disable save) bit of their own Table 5 17) after performing the specified LOG SELECT

bit specifies they are savable.

Table .17

SP	DS	
1	0	Log Parameter Saved
1	1	Log Parameter Not Saved

X - Don t care

The type of parameter value is defined by the PC (page control) field.
Table 5 18.

5. Page Control Field (PC)

Bit 7		Type of Parameter Values	
		LOG SENSE	
0	0		Threshold Values
0		Current Cumulative Values	Cumulative Values
	0	Default Threshold Values	
1	1		Default Cumulative Values

The current threshold value can only be modified by the initiator via the LOG $_B$ and putting the new threshold value in

log parameter is ignored by the drive in this case.

The current cumulative values may be updated by the drive or by the initiator using

by the drive. This is done by the combination of PC field (01_B
update) bit in the parameter control byte.

The initiator can request the drive to set the current threshold parameters to the

10_B

The drive will set all cumulative parameters to their default values in response to a LOG SELECT command with the PC field set to 11 and the parameter list length field set to zero.

The parameter list length field designates the length in bytes of the log parameter list (log pages) to be transferred from the initiator to the drive in the phase of DATA OUT. A parameter list of zero indicates no log pages will be sent out from the initiator. This condition will not be treated as an error.

If page codes or parameter codes within the parameter list sent out by the initiator are reserved or not implemented by the drive, the drive will terminate the LOG SELECT command with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST and the additional sense code will be INVALID FIELD IN PARAMETER LIST.

If a parameter list length results in the truncation of any log parameter the drive will terminate the command with CHECK CONDITION status. The sense key will be ILLEGAL REQUEST and the sense code will be INVALID FIELD IN PARAMETER LIST.

The log pages should be sent in ascending order by page code value if multiple pages are sent by the initiator. The log parameters also have to be sent in ascending order by parameter code value if multiple log parameters within a page are sent. The drive will return CHECK CONDITION status if the initiator sends or parameters out of order. In this case, the sense key will be ILLEGAL REQUEST and the sense code will be INVALID FIELD IN PARAMETER LIST.

Initiators shall issue LOG SENSE commands to determine supported pages and page lengths before issuing LOG SELECT commands.

The drive supports only one set of log parameters for all the initiators. Therefore, if one initiator modifies a log parameter that will affect other initiators, the drive will generate an UNIT ATTENTION condition for all initiators except the one that issues the LOG SELECT command to change it. This UNIT ATTENTION condition is returned with an additional sense code of LOG PARAMETERS CHANGED.

[Log Pages]

Following a LOG SELECT command, zero or more log pages can be sent out by the initiator in a DATA OUT phase. Only one log page will be returned by the drive in a DATA IN phase after received a LOG SENSE command. A log page starts with four-byte page header followed by zero or more variable-length log parameters for that page. The log page format is shown as Table 5.19.

5. Log Page Format

Bit	7	6		4	3		1	0
0	Reserved		Page Code					
1	Reserved							
2	(MSB) Page Length (n)							
3	(LSB)							
Log Parameter (s)								
4 • x+3	Log Parameter (First) (Length x)							
• •								
n+4-y • n+3	Log Parameter (Last) (Length y)							

The page code field specified which log page is transferred. The page code assignments for the log pages are listed in Table 5.20.

Table 5.20 Log Page Codes

Page Code	Description
00_H	Supported Log Pages
01_H	Not Supported
02_H	Error Counter Page (Write) Page
03_H	Error Counter Page (Read) Page
04_H	Reserved
05_H	Error Counter Page (Verify) Page
06_H	Non-Medium Error Page

(cont'd)

Table 5.20 Log Page Codes (cont'd)

07_H	Last n Error Events Page
08_H- $0C_H$	Reserved
$0D_H$	Temperature Page
$0E_H$	Start-Stop Cycle Counter Page
$0F_H$	Application Client Page
10_H	Self-Test Results Page
$11_H – 2E_H$	Reserved
$2F_H$	Informational Exceptions Page
$30_H – 3D_H$	Vendor Specific
$3E_H$	Factory Log Page
$3F_H$	Reserved

The page length field specifies the length in bytes of the following log parameters that will be transferred between the initiator and the drive.
During a LOG SELECT command, if the initiator sends a page length that results in the truncation of any parameter, the drive will terminate the command with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.
If the Log Page Code is set to 01_H, 04_H, or 08_H-$3F_H$, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

[Log Parameters]

A log page may contain one or more log parameters (Table 5.21). Log parameters may be data counters which record a count of a particular event(s) that experienced by the drive or list parameters (strings) which contain a description of a particular event.
Each log parameter (Table 5.21) begins with a four-byte parameter header followed by one or more bytes of parameter value data.

Table 5.21 Log Parameter

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB) Parameter Code							
1								(LSB)

(cont'd)

LOG SELECT:(4Ch)

Table 5.21 Log Parameter (cont'd)

2	DU	DS	TSD	ETC	TMC	LBIN	LP
3	Parameter Length (n-3)						
4	(MSB) Parameter Value						
n	(LSB)						

The Parameter Code field specifies which log parameter, data counter or list parameter, is being transferred for that log page.

The DU, DS, TSD, ETC, TMC, and LP fields are together referred to as the parameter control byte.

Bit 7 : DU (Disable Update) bit

The DU bit indicates the status of log parameter updating.
The updating is done in the internal memory of the embedded controller.
Therefore, if the updating is not yet saved to the disk, requested by the initiator or done by the drive automatically, the updated parameter values will be lost during a power failure.

-- LOG SELECT usage -- :
For cumulative log parameter values the DU bit is defined as follows :

A zero value of DU bit indicates that the drive will increment the cumulative log parameter value whenever an event should be noted by that parameter.

A one value of DU bit indicates that the drive will not update the log parameter value except in response to a LOG SELECT command that specifies a new value for the parameter.

The DU bit is not defined for threshold values nor for list parameters.
The drive will ignore the value of any DU bits in a LOG SELECT command.
To update the current threshold values , just pass the new value in the parameter value field and specify the PC field to 00_B.

LOG SELECT:(4Ch)

-- LOG SENSE usage -- :
A zero value of DU bit of a cumulative log parameter means the updating of that parameter is enabled. The drive will increment the cumulative log parameter value whenever an event should be noted by that parameter. A one value of DU bit for a cumulative log parameter means the updating of that parameter is disabled.

The value of DU bit is a “don’t care” for the threshold values and list parameters.

Bit 6 : DS (Disable Save) bit
The DS bit in conjunction with the SP bit in the CDB is utilized to define if the drive should save the specified log parameter cumulative or threshold value to the disk after it performs a LOG SELECT or LOG SENSE command. Table 5.15 shows all the conditions.

The value of DS bit is a "don't care" for the list parameter because the save function of list parameter is not supported.

Bit 5 : TSD (Target Save Disable) bit
A TSD bit indicates the capability of the drive-defined log parameters saving. If TSD bit is enabled, the drive will automatically save the cumulative parameter values every hour to insure they retain statistical significance (i.e., across power cycles).

The TSD bit of a list parameter is “don’t care”. The controller will automatically save all the list parameters onto the drive every hour if any of the TSD bits of data counters of any other pages (01_H-06_H) is set to zero.

-- LOG SELECT usage -- :
A zero value of TSD bit indicates the initiator requests the drive to turn on the drive-defined saving operation. A one value of TSD bit is used by the initiator to disable the saving operation.

If the initiator sets both the DS and the TSD bits to one, the drive will terminate the LOG SELECT command with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

-- LOG SENSE usage -- :
A zero value of TSD bit means the drive-defined saving operation is supported and enabled. On the other hand, one means it is disabled.

LOG SELECT:(4Ch)

Bit 4 : ETC (Enable Threshold Comparison) bit

An enable threshold comparison (ETC) bit controls the comparison operation of threshold value and cumulative value of a log parameter. The ETC bit is only defined for cumulative and threshold parameters which are specified by the PC field in the CDB.

If the ETC bit is set to one, the RLEC bit(Refer to Table 5.37 Control Mode Page : Page Code = A_H) is set to one and the result of the comparison is true, a UNIT ATTENTION condition will be generated for all initiators. A sense key of UNIT ATTENTION, a sense code of LOG EXCEPTION, and additional sense code qualifier of THRESHOLD CONDITION MET will be returned to all initiators by the drive.

-- LOG SELECT usage -- :

A one value of ETC bit indicates the initiator requests that a comparison to the threshold value is performed whenever the cumulative value is updated. A zero value of ETC bit indicates that a comparison is not to be performed.

-- LOG SENSE usage -- :

A one value of ETC bit indicates the threshold comparison operation is enabled. A zero value of ETC bit indicates the threshold comparison operation is disabled.

Bit 3,2 : TMC (Threshold Met Criteria) bit

The TMC field (Table 5.22) defines the basis for comparison of the cumulative and threshold values. The TMC field is valid only if the ETC bit is one.

Table 5.22 Threshold Met Criteria

Bit 3	Bit 2	Basis for Comparison
0	0	Every update of the cumulative value
0	1	Cumulative value equal threshold value
1	0	Cumulative value not equal threshold value
1	1	Cumulative value greater than threshold value

Bit 1 : LBIN bit

The LBIN bit is only valid if the LP is one. If the LP bit is one and the LBIN bit is zero then

the list parameter is a string of ASCII graphic codes. If the LP bit is one and the LBIN bit is

one then the list parameter is a list of binary information.

LOG SELECT:(4Ch)

Bit 0 : LP (List Parameter) bit

The LP bit indicates the type of the log parameter, data counter or list parameter.

If an initiator attempts to set the value of the LP bit to a value other than the one returned for the same parameter in the LOG SENSE command, the drive will terminate the command with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST and the additional sense code will be INVALID FIELD IN PARAMETER LIST.

An LP bit of zero indicates that the parameter is a data counter. Data counters are associated with one or more events. Its cumulative parameter value will be incremented whenever one of those associated events occurs and the DU bit is zero. Each data counter has its own drive-defined maximum value. Upon reaching this maximum value, the drive will set the data counter associated DU bit to one to prevent further updating of this counter. And incrementing of all counters in the same log page will be ceased until re- initialized by the initiator via a LOG SELECT command. If the data counter is at or reaches its maximum value during the execution of a command, the drive will complete the command. If the command completes correctly (except the data counter being at its maximum value) and if RLEC (Report Log Exception Condition) bit of the control mode page is set to one, then the drive will terminate the command with CHECK CONDITION status and set the sense key to RECOVERED ERROR with the additional sense code set to LOG COUNTER AT MAXIMUM.
An LP bit of one indicates that the parameter is a list parameter. List parameters are not counters and thus the ETC and TMC fields shall be set to zero by the initiator.

If more than one list parameter is defined in a single log page, the following rules apply to assigning parameter codes :

1. The list parameter updated last will have a higher parameter code than the previous list parameter, except as described in rule 2.

2. When the maximum parameter code value supported by the drive, determined by the available memory size, the drive will assign the lowest parameter code value to the next list parameter (i.e., wraparound parameter codes). If the associated command completes correctly (except for the parameter code being at its maximum value) and if the RLEC bit of the control mode page is set to one, then the drive will terminate the command with CHECK CONDITION status and set the sense key to RECOVERED ERROR with the additional sense code set to LOG LIST CODES EXHAUSTED.

LOG SELECT:(4Ch)

The Parameter Length field specifies the length in bytes of the following Parameter Value field. If the initiator sends a parameter length value that results in the truncation of the parameter value, the drive will terminate the command with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the initiator sends a log parameter value that is not supported by the drive, the drive will terminate the command with CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN PARAMETER LIST.

Supported Log Pages (Page Code = 00_H)

The supported log page is only defined for LOG SENSE command.
It returns the list of log pages implemented by the drive.

Table 5.23 Supported Log Pages

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code(00_H)					
	0	0	0	0	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB)							
	Page Length ($000A_H$)							
3								(LSB)
4	00_H (Supported Log Page)							
5	02_H (Error Counter Write Page)							
6	03_H (Error Counter Read Page)							
7	05_H (Error Counter Verify Page)							
8	06_H (Non-Medium Error Page)							
9	07_H (Last n Error Events Page)							
10	$0D_H$ (Temperature Page)							

(cont'd)

LOG SELECT:(4Ch)

Table 5.23 Supported Log Pages (cont'd)

11	$0E_H$ (Start-Stop cycle counter Page)
12	$0F_H$ (Application client Page)
13	10_H (Self-Test Results Page)
14	$2F_H$ (Informational Exceptions Page)
15	$3E_H$ (Factory Log Page)

The page length field specifies the length in bytes of the following supported page list. There is one byte for one page code ; therefore, the page length also indicates the total number of log pages supported by the drive.

The supported page list field will contain a list of all log page codes implemented by the drive in ascending order beginning with page code 00_H.

Error Counter Log Pages (Page Code = 02_H, 03_H, 05_H)

The formats of three supported error counter pages, read (page code 3_H), write (page 2_H), and verify (page 5_H), are the same. The error counter page for read operation is defined in Table 5.24 to represent all three pages. A page can return one or more error counters which record events defined by the parameter codes (Table 5.25).

Table 5.24 Error Counter Read Page (Page Code = 3_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	0	0	0	0	1	1
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB)							
	Page Length (n)							
3								(LSB)

(cont'd)

Table 5.24 Error Counter Read Page (Page Code = 3H) (cont'd)

Error Counter (s)							
4	(MSB) Parameter Code						
5	(LSB)						
6	DU	DS	TSD	ETC	TMC	LBIN 0	LP 0
7	Parameter Length (8)						
8	(MSB) Parameter Value						
•							
•							
15	(LSB)						
n-8	Error Counter (Last) (Length 12)						
•							
•							
n+3							

Table 5.25 Parameter Codes for Error Counter Pages

Parameter Code	Description
0000_H	Error sectors corrected on the fly ECC
0001_H	Error sectors corrected by ECC with possible delays (Note 1)
0002_H	Error sectors recovered with re-writes or re-reads
0003_H	Total error sectors recovered
0004_H	Total times tried to recover
0005_H	Total bytes processed in block size
0006_H	Total unrecovered error sectors
0007_H -$7FFF_H$	Reserved
8000_H -$FFFF_H$	Vendor Unique

Note 1 : In case of error counter write page, a zero value will be returned on LOG SENSE command. A GOOD status will be returned on LOG SELECT command but no other actions will be performed.

Note 2 : The contents of error counter are vendor unique.

LOG SELECT:(4Ch)

Non-Medium Error Page (Page Code = 06_H)

This page records the occurrences of recoverable error events other than write, read, or verify failures. This controller provide two vender specific error counters : track following error and positioning error (Table 5.27). Both of these vendor specific error counts are included in the non-medium error count.

Table 5.26 Non-Medium Error Page (Page Code = 6_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	0	0	0	1	1	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB) Page Length (n)							
3								(LSB)
	Error Counter (s)							
4	(MSB) Parameter Code							
5								(LSB)
6	DU	DS	TSD	ETC	TMC		LBIN 0	LP 0
7	Parameter Length (8)							
8	(MSB) Parameter Value							
•								
•								
15								(LSB)
	|							
n-8	Error Counter (Last) (Length 12)							
•								
•								
n+3								

LOG SELECT:(4Ch)

Table 5.27 Non-Medium Error Event Parameter Codes

Parameter Code	Description
0000_H	Non-Medium Error Count
0001_H-$7FFF_H$	Reserved
8000_H-$FFFF_H$	Vendor-Specific Error Counts
8009_H	Track Following Error
8015_H	Positioning Error

Last n Error Events Page (Page Code = 07_H)

Log page 7_H is a list parameter page. Each list parameter is an error-event record which contains drive-specific diagnostic information for a single error encountered by the drive. There are 23 of these error-event records supported by this controller. The length of a list parameter and the kinds of error-events will be supported are defined in the following Table 5.28. The content of the parameter value field of each log PARAMETER is an ASCII character string which may describe the error event. The exact contents of the character string is also in the same table.

Table 5.28 Last n Error Events Page(Page Code = 7_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	0	0	0	1	1	1
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB) Page Length (n)							
3								(LSB)
Error Counter (s)								
4	(MSB) Parameter Code							
5								(LSB)
6	DU	DS	TSD	ETC	TMC		LBIN	LP
				0	0	0	0	1

(cont'd)

LOG SELECT:(4Ch)

Table 5.28 Last n Error Events Page(Page Code = 7H) (cont'd)

7	Parameter Length (x)
8	(MSB)
•	Event Description
x+7	(LSB)
	|
	|
n-y+4	
•	Error Event (Last)
n+3	(Length y)

The parameter code in an error-event record indicates the relative time at which the error occurred. The higher the parameter code indicates the later an error event occurred. The valid parameter codes supported by this controller are from 0000_H to $FFFF_H$.

When the drive reaches beyond the last supported parameter code ($FFFF_H$) for an error-event record, then a parameter code of (000_H) is to be taken as wraparound codes.

Temperature Page (Page Code = $0D_H$)

This clause defines the optional temperature log page(page code $0D_H$).
The temperature sensed in the device at the time the LOG SENSE command is performed shall be returned in the parameter field defined by parameter code $0000_{H.}$
Temperature equal to or less than zero Degrees Celsius shall be indicated by a value of zero. If a valid temperature cannot be detected because of a sensor failure or other condition, the value returned shall be $FF_{H.}$
The temperature should be reported with an accuracy of plus or minus three Celsius Degrees while the device is operating at a steady state within the environmental limits specified for the device.

A reference temperature for the device provided by the device using parameter code 0001_H.
The one byte binary value should reflect the maximum reported sensor temperature in degrees Celsius at which the device is capable of operating continuously without degrading the device's operation or reliability beyond manufacture accepted limit.

LOG SELECT:(4Ch)

Table 5.29 Temperature Page(Page Code = D_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	0	0	1	1	0	1
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB) Page Length (12)							
3								(LSB)
4	Parameter Code (MSB)							
	0	0	0	0	0	0	0	0
5	Parameter Code (LSB)							
	0	0	0	0	0	0	0	0
6	DU	DS 1	TSD	ETC	TMC		LBIN 1	LP 1
7	Parameter Length (2)							
8	Reserved							
	0	0	0	0	0	0	0	0
9	Temperature (Degrees Celsius)							
10	Parameter Code (MSB)							
	0	0	0	0	0	0	0	0
11	Parameter Code (LSB)							
	0	0	0	0	0	0	0	1
12	DU	DS 1	TSD	ETC	TMC		LBIN 1	LP 1
13	Parameter Length (2)							
14	Reserved							
	0	0	0	0	0	0	0	0
15	Reference Temperature (Degrees Celsius)							

Start-Stop Cycle Counter Page (Page Code = $0E_H$)

This clause defines the optional start-stop cycle counter page(page code $0E_{.H}$).
A device that implements the start-stop cycle counter page shall implement one or more of the defined parameters. Table 5.30 shows the start-stop cycle counter page with all parameters present.

LOG SELECT:(4Ch)

Table 5.30 Start-Stop Cycle Counter Page(Page Code = $0E_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	0	0	1	1	1	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB) Page Length (24_H)							
3								(LSB)
4	(MSB) Parameter Code (0001_H)							
5	Date of Manufacture							(LSB)
6	DU	DS	TSD	ETC	TMC		LBIN	LP
7	Parameter Length (06_H)							
8	(MSB)							
•								
•	Year of Manufacture (4 ASCII Characters)							
11								(LSB)
12	(MSB)							
13	Week of Manufacture (2 ASCII Characters)							(LSB)
14	(MSB) Parameter Code (0002_H)							
15	Accounting Date							(LSB)
16	DU	DS	TSD	ETC	TMC		LBIN	LP
17	Parameter Length (06_H)							
18	(MSB)							
•								
•	Accounting Date Year (4 ASCII Characters)							
21								(LSB)

(cont'd)

LOG SELECT:(4Ch)

Table 5.30 Start-Stop Cycle Counter Page(Page Code = 0EH) (cont'd)

22	(MSB) Accounting Date Week (2 ASCII Characters)						
23	(LSB)						
24	(MSB) Parameter Code (0003H) Specified Cycle Count Over Device Lifetime						
25	(LSB)						
26	DU	DS	TSD	ETC	TMC	LBIN	LP
27	Parameter Length (04_H)						
28	(MSB) Specified Cycle Count Over Device Lifetime (4 Byte Binary Number)						
•							
•							
31	(LSB)						
32	(MSB) Parameter Code (0004_H) Accumulated Start-Stop Cycles						
33	(LSB)						
34	DU	DS	TSD	ETC	TMC	LBIN	LP
35	Parameter Length (04_H)						
36	(MSB) Accumulated Start-Stop Cycles (4 Byte Binary Number)						
•							
•							
39	(LSB)						

The year and week in the year that the device was manufactured shall be set in the parameter field defined by parameter code 0001_H. The date of manufacture shall not be savable by the initiator via the LOG SELECT command. The date is expressed in numeric ASCII characters (30_H - 39_H) in the form YYYYWW, as shown in Table 5.30.

The accounting date specified by parameter code 0002H is a parameter that may optionally be savable via the LOG SELECT command to indicate when the device was placed in service.

LOG SELECT:(4Ch)

If the parameter is not yet set or is not settable, the default value placed in the parameter field shall be 6 ASCII blank characters(20_H). The field shall not be checked for validity by this controller.

The Specified cycle count over device lifetime (parameter code 0003_H) is a parameter provided by this controller. The specified cycle count over device lifetime parameter shall not be savable by initiator via the LOG SELECT command. The parameter value is a 4 byte binary number.

The value indicates how many stop-start cycle may typically be executed over the lifetime of the device without degrading the device's operation or reliability outside the limits specified by the manufacture of the device.

The accumulated start-stop cycles (parameter code 0004h) is a parameter provided by this controller. The accumulated start-stop cycles parameter shall not be savable by initiator via the LOG SELECT command. The parameter value is a 4-byte binary number. The value indicates how many start-stop cycles the device has detected since its date of manufacture.

Application Client Page (Page Code = $0F_H$)

The application client page (see Table 5.31) provides a place for application clients to store system information. The page code for the application client page is 0Fh.

Table 5.31 Application Client Page(Page Code = $0F_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	0	0	1	1	1	1
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB)							
	Page Length (4000_H)							
3								(LSB)

(cont'd)

Table 5.31 Application Client Page(Page Code = 0FH) (cont'd)

Application Client Log Parameters	
4 • • 259	First Application Client Log Parameter
	|
16132 • • 16387	64th Application Client Log Parameters

Parameter codes 0000h through 003Fh are for general usage application client data. The intended use for this information is to aid in describing the system configuration and system problems, but the exact definition of the data is application client specific. The general usage application client data parameters all have the format shown in Table 5.32.

Table 5.32 General usage application client parameter data

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB) Parameter Code (0000_H to $003F_H$)							
1								(LSB)
2	DU 1	DS 0	TSD 0	ETC 0	TMC		LBIN 1	LP 1
3	Parameter Length (FC_H)							
4 • • 255	General Usage Parameter Bytes							

For general usage application client data, the value in the Parameter Code field shall be between 0000h and 003Fh. The first supported general usage application client parameter code shall be 0000h and additional supported parameters shall be sequentially numbered.

LOG SELECT:(4Ch)

The general usage parameter is savable by initiator via the LOG SELECT Command.

If the parameter is not yet set, the default value placed in the parameter field shall be all zero data.

If the parameter control field(byte2) is not satisfied in Table 5.32, the CHECK CONDITION Status with the ILLEGAL REQUEST Sense key is reported.

Self-Test Results Page (Page Code = 10_H)

The Self-Test Results log page provides the results from the twenty most recent self-tests.
Results from the most recent self-test or the self-test currently in progress shall be reported in the first self-test log parameter; results from the second most recent self-test shall be reported in the second self-test log parameter; etc. If fewer than twenty self-tests have occurred, the unused self-test log parameter entries shall be zero filled.

Table 5.33 Self-Test Results Page(Page Code = 10_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	0	1	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB)							
3	Page Length (190_H)							(LSB)
Self-Test Results Log Parameters								
4	First Self-Test Results Log Parameters							
•								
•								
23								
	|							
	|							
384	Twentieth Self-Test Results Log Parameters							
•								
•								
403								

LOG SELECT:(4Ch)

Table 5.34 shows the format of one self-test log parameter.

Table 5.34 Self-Test Results Log Parameter Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB) Parameter Code (0001_H to 0014_H)							
1								(LSB)
2	DU 0	DS 0	TSD 0	ETC 0	TMC		LBIN 1	LP 1
3	Parameter Length (10_H)							
4	Self-Test Code			Reserved 0	Self-Test Results			
5	Self-Test Number							
6	(MSB) Time Stamp							
7								(LSB)
8	(MSB) Address of First Failure							
•								
•								
15								(LSB)
16	Reserved 0	0	0	0	Sense Key			
17	Additional Sense Code							
18	Additional Sense Code Qualifier							
19	Vendor-Specific							

The Parameter Code field identifies the log parameter being transferred.The Parameter Code field for the results of the most recent self-test shall contain 0001_H; the Parameter Code field for the results of the second most recent test shall contain 0002_H; etc.

The Self-Test Code field contains the value in the Self-Test Code field of the SEND DIAGNOSTIC command(see 5.29) that initiated this self-test.

Table 5.35 Self-Test Results Values

Self-Test Results Value	Description
0_H	The self-test completed without error.
1_H	The background self-test was aborted by the application client using a SEND DIAGNOSTIC command(see 5.29) with the Self-Test Code field set to (100)b (Abort background self-test).
2_H	The self-test routine was aborted by an application client using a method other than a SEND DIAGNOSTIC command(see 5.29) with the Self-Test Code field set to (100)b.
3_H	An unknown error occurred while the device server was executing the self-test and the device server was unable to complete the self-test.
4_H	The self-test completed with a failure in a test segment, and the test segment that failed is not known.
5_H	The first segment of the self-test failed.
6_H	The second segment of the self-test failed.
7_H	Another segment of the self-test failed (see the Self-Test Segment Number field).
8_H-E_H	Reserved
F_H	The self-test is in progress.

The Self-Test Number field identifies the self-test that failed and consists of either:

1) the number of the segment that failed during the set-test; or
2) the number of the test that failed and the number of the segment in which the test was run, using a vendor specific method for placing the two values in the one field.

When the segment in which the failure occurred cannot or need not be identified, the Self-Test Number field shall contain 00_H.

The Time Stamp field contains the total accumulated power-on hours for the device server at the time the self-test was completed. If the test is still in progress, the content of the Time Stamp field shall be zero. If the power-on hours for the device at the time the self-test was completed is greater than $FFFF_H$ then the content of the Time Stamp field be $FFFF_H$.

LOG SELECT:(4Ch)

The Address of First Failure field contains information that locates the failure on the media. If the logical unit implements logical blocks, the content of the Address of First Failure field is the first logical block address where a self-test error occurred. This implies nothing about the quality of any other logical block on the logical unit, since the testing during which the error occurred may not have been performed in a sequential manner. This value shall not change. The content of the Address of First Failure field shall be $FFFFFFFFFFFFFFFF_H$ if no errors occurred during the self-test or if the error that occurred is not related to an identifiable media address.

The Sense Key, Additional Sense Code, and Additional Sense Code Qualifier field may contain a hierarchy of additional information to error or exception conditions that occurred during the self-test represented in the same format used by sense data.

Informational Exceptions Page (Page Code = $2F_H$)

Table 5.36 Informational Exceptions Page (Page Code = $2F_H$)

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	1	0	1	1	1	1
1	Reserved							
	0	0	0	0	0	0	0	0
2	(MSB) Page Length (0008_H)							
3								(LSB)
4	(MSB) Parameter Code (0000_H)							
5								(LSB)
6	DU	DS	TSD	ETC	TMC		LBIN	LP
	0	0	0	0			0	0
7	Parameter Length (04_H)							
8	Informational Exception Additional Code							

(cont'd)

LOG SELECT:(4Ch)

Table 5.36 Informational Exceptions Page (Page Code = 2FH) (cont'd)

9	Informational Exception Additional Sense Code Qualifier
10	Current Measured Temperature(Degrees Celsius)
11	Maximum Temperature Threshold(Degrees Celsius)

If the informational exception additional sense code field contains zero, no informational exception condition is pending and contents of the informational exception additional sense code qualifier field are unspecified. If the informational exception additional sense code field contains any value other than zero, an informational exception condition exists that has an additional sense code indicated by informational exception additional sense code field and an additional sense code qualifier indicated by the informational exception additional sense code qualifier field.

The current measured temperature field reports temperature of the device. Temperature equal to or less than zero Degrees Celsius shall be indicated by a value of zero. If a valid temperature cannot be detected because of a sensor failure or other condition, the value returned shall be $FF_{H.}$
The temperature should be reported with an accuracy of plus or minus three Celsius Degrees while the device is operating at a steady state within the environmental limits specified for the device

The maximum temperature threshold field reports maximum temperature threshold of the device.

Factory Log Page (Page Code = $3E_H$)

Table 5.37 Factory Log Page (Page Code = $3E_H$)

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
	0	0	1	1	1	1	1	0
1	Reserved							
	0	0	0	0	0	0	0	0

(cont'd)

Table 5.37 Factory Log Page (Page Code = 3EH) (cont'd)

2	(MSB) Page Length (0008_H)						
3	(LSB)						
4	(MSB) Parameter Code (0000_H)						
5	(LSB)						
6	DU 0	DS 0	TSD 0	ETC 0	TMC	LBIN 0	LP 0
7	Parameter Length (04_H)						
8 | 11	(MSB) Power On Time (LSB)						
12	(MSB) Parameter Code (0008_H)						
13	(LSB)						
14	DU 0	DS 0	TSD 0	ETC 0	TMC	LBIN 0	LP 0
15	Parameter Length (04_H)						
16 | 19	(MSB) Next S.M.A.R.T. Measurement Time (LSB)						

The parameter code 0000_H is Power On Time. This parameter code represents the number of the controller power on minutes.

The parameter code 0008_H is Next S.M.A.R.T. Measurement Time. This parameter reports the time, in minutes, to the next scheduled interrupt for a S.M.A.R.T. measurement.

LOG SELECT:(4Ch)

5.4 H)

Byte	7		5	4		2	1	
0	Operation Code (4D)							
	0		0	0		1	0	
1	Logical Unit Number						PPC	SP
					0	0		
2	PC							
3	Reserved							
		0	0		0	0		0
4								
	0	0		0	0		0	0
	(MSB) Parameter Pointer							
								(LSB)
7	Allocation Length							
8								
9	Vendor Unique						Flag	Link
	0		0		0	0		

statistical information maintained by the drive. This command allows the initiator to request only one log page from the drive at a time.

specified log page of parameter code values (16-bit unsigned integers) which has been updated since the last LOG SELECT or SENSE command. And only those

A PPC bit of zero will cause the drive to return the number of bytes specified by the allocation length field in ascending order of parameter codes beginning with the

parameter pointer field of zero will cause the drive to return all available log parameters for the specified log page to the initiator subject to the allocation length.

PPC = 0 only.

LOG SENSE:(4Dh)

The SP bit works as it does in the LOG SELECT command. It provides the option for the initiator to save all log parameters, identified as savable by the DS bit, of the specified log page to the disk after the LOG SENSE operation has been performed.

The PC (page control) field defines the type of parameter values to be selected (see Table 5.18). The parameter values returned by a LOG SENSE command are determined as the following priority list :

1. The last updated parameter values.
2. The saved values are returned if an update has not occurred since the last power-on, hard RESET condition, or BUS DEVICE RESET message.
3. The default values are returned if an update has not occurred since the last power-on, hard RESET condition, or BUS DEVICE RESET message and saved values are not available.

The Page code field specifies which log page is requested from the drive.
A reserved or not implemented page code requested by the initiator will cause the drive to terminate the command with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST and the additional sense code will be INVALID FIELD IN CDB.

The parameter pointer field is used by the initiator to request log parameters beginning from a specific parameter code to the maximum allocation length or the maximum parameter code supported by the drive, whichever is less. If the value of the parameter pointer field is larger than the largest supported parameter code of the specified log page, the drive will terminate the command with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST and the additional sense code will be INVALID FIELD IN CDB.

Log parameters within the specified log page will be returned in ascending parameter code order.

The Log Sense page format is as described in the LOG SELECT command (section 5.3).

5.5 MODE SELECT:(15_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (15_H)							
	0	0	0	1	0	1	0	1
1	Logical Unit Number			PF	Reserved			SP
					0	0	0	
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Parameter List Length							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The MODE SELECT command provides a means for the host computer to specify or change medium, logical unit, controller, or peripheral device parameters to the controller. There are some parameters which cannot be changed by the host computer.
With this command the host computer can control error recovery, disconnection / reconnection, medium formatting, and caching.

The MODE SELECT command is used with the MODE SENSE command (see 5.7).
The MODE SENSE command is used to request the controller to transfer parameters to the host computer.

The controller manages the following three types of values as MODE SELECT data :

- Default values: The default values are stored in the system area written within the drive.

- Current values: The current values are used by the controller during operations and stored in controller RAM.

- Saved values: The saved values are stored in the system area of the drive. The controller saves the current values on the drive as specified by the host computer with the MODE SELECT or FORMAT UNIT command.
  These values become the latest saved values.

By making use of the save function, the host computer can eliminate the reissuing of the MODE SELECT command each time the controller is powered on; that is, the controller can automatically restore the current values from the saved values.

The PF (Page Format) bit is ignored. All data must comply to the pages as described in this manual.

The SP (Save Parameters) bit, when set to 1, indicates that the controller saves this specified page and parameters (current values) into the system area of the drive after updating the parameters in the specified page. The following pages are savable:

- Read-write error recovery page (page code 1_H)
- Disconnect-reconnect page (page code 2_H)
- Verify error recovery page (page code 7_H)
- Caching page (page code 8_H)
- Control mode page (page code A_H)
- Informational Exceptions Condition page (page code $1C_H$)

When the SP bit is set to 0, the controller only updates the parameters and does not save them.

The Parameter List Length specifies the length in bytes of the MODE SELECT parameter list to be transferred in the Data Out phase. A parameter list length of 0 specifies that no data is to be transferred. This condition, however, is not considered an error.

The Mode Select Parameter List (Table 5.38) consists of a 4-byte header, followed by zero or one block descriptors, followed by zero or more page descriptors.

The 4-byte Mode Select header must always be transferred whenever the Mode Select parameter list is transferred. If this is not satisfied, the CHECK CONDITION status with ILLEGAL REQUEST sense key is reported.

The controller will create the CHECK CONDITION status with ILLEGAL REQUEST sense key if an invalid field or bit value is specified as follows:

If the controller cannot implement the exact value of parameter requested by the host computer and the parameter rounding is permitted, the controller rounds the value to its nearest value within its supporting range. In this case, the controller creates CHECK CONDITION status with RECOVERED ERROR sense key after executing the command and the additional sense code (Sense data byte 12) set to 37_H (ROUNDED PARAMETER).
The host computer can also check the rounded value using a MODE SENSE command requesting the current value.

MODE SELECT:(15h)

If the controller receives a parameter value that it does not support and the parameter rounding is not permitted, it rejects the command returning the CHECK CONDITION status with ILLEGAL REQUEST sense key.

Table 5.38 Mode Select Parameter List

Byte \ Bit	7	6	5	4	3	2	1	0
MODE SELECT Header								
0	Reserved 0	0	0	0	0	0	0	0
1	Medium Type(00_H) 0	0	0	0	0	0	0	0
2	WP	Reserved 0	0	DPOFUA	Reserved 0	0	0	0
3	Block Descriptor Length							
Block Descriptor								
0	Number of Blocks (MSB)							
1	Number of Blocks							
2	Number of Blocks							
3	Number of Blocks (LSB)							
4	Reserved 0	0	0	0	0	0	0	0
5	Block Length (MSB)							
6	Block Length							
7	Block Length (LSB)							
Page Descriptor (s)								
0	Reserved 0	SPF 0	Page Code					
1	Page Length (in bytes)							
2-n	Refer to each Page							

MODE SELECT:(15h)

The page descriptor(s) case of page_0 mode page format is defined in Table 5.38.

The page descriptor(s) case of sub_page mode page format is defined in Table 5.39.

Table 5.39 Mode Select (Sub_Page Mode) Page Descriptor(s)

Bit / Byte	7	6	5	4	3	2	1	0
Page Descriptor (s)								
0	Reserved 0	SPF 1	Page Code					
1	Sub Page Code							
2-3	Page Length (in bytes)							
4-n	Refer to each Page							

The Medium Type field must always be loaded with code 00_H and identify the default medium type.

The controller ignores WP and DPOFUA bit in MODE SELECT command.

The Block Descriptor Length field specifies the total length in bytes of the block descriptors. The eligible length values are 0 and 8. This means that at most one block descriptor can be specified.

The Block Descriptor field specifies the area on the medium that is accessible to the host computer.

The Number of Blocks field specifies the number of logical blocks on the medium that satisfy the block length in the block descriptor. The number of blocks field = 0 indicates that the number of blocks value is not changed from the current value if the block length of the Block Descriptor remains the same as the current value. And if the block length of the Block Descriptor is different from the current value, the controller uses the default maximum number of blocks as the number of blocks value.

The block length field specifies the length in bytes of the logical block.

Please refer to “Product Specifications” for the information of the eligible block length values.

Each page is preceded by a 2-byte or 4-byte page header that defines the SPF(Sub Page Format) and page code and page length.

The Page Code field specifies the meaning of the bytes following the page length field. The Page Code field must be loaded with a page code that is supported by the controller. The page codes supported by the SCSI controller are listed below.

Page Code	Meaning
1_H	Read-write error recovery page
2_H	Disconnect-reconnect page
3_H	Format device page
4_H	Rigid disk geometry page
7_H	Verify error recovery page
8_H	Caching page
A_H	Control mode page
C_H	Notch and partition page
18_H	Logical unit control page
19_H	Port control page
$1A_H$	Power condition page
$1C_H$	Informational exceptions control page

The Page Length field specifies the number of bytes that follow the page length field. The Page Length field must be loaded with a page length value that is supported by the controller. This value is reported by the controller to the host computer by checking it in the page length field of the Mode Sense data.

The controller assumes and reports a contiguous page area even if the page contains unsupported fields.

The host computer can transfer all pages supported by the controller including unchanged pages. The page codes may be specified in any order.

The controller manages the current and saved values on page 19_H for each host computer (initiator) . Consequently, the host computers that are connected to the controller can control the functions specified on pages 19_H independently.

The block descriptors and page code 19_H sub page code 03_H are managed on a controller unit basis.
When value in these areas are changed, the controller reports the CHECK CONDITION status with UNIT ATTENTION sense key to the first command sent by any initiator other than the one that changed these value. The host computer must load 0's into the corresponding fields and bits that are flagged as unchangeable in the Mode Sense data.

MODE SELECT:(15h)

Precautions to be observe on the host computer side

It is recommended that the host computer issue a MODE SENSE command requesting the controller to return all changeable values prior to issuing any MODE SELECT commands, in order to find out the pages supported by the controller, page lengths, and changeable fields or bits.

It is recommended that the host computer issues the RESERVE UNIT command prior to executing the MODE SELECT command which intends to change the page 3_H (Format parameter) and/or page 4_H (Geometry parameter), and issues the RELEASE UNIT command after the completion of the FORMAT UNIT command. This procedure will prevent another host computer from issuing different Mode Select parameters to the same unit prior to the execution of the FORMAT UNIT command.

[Mode Page 1_H]

Table 5.40 Read - Write Error Recovery Page (Page Code = 1_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(01_H)					
	0	0	0	0	0	0	0	1
1	Page Length($0A_H$)							
	0	0	0	0	1	0	1	0
2	AWRE	ARRE	TB	RC	EER	PER	DTE	DCR
3	Read Retry Count							
4	Correction Span							
5	Head Offset Count							
6	Data Strobe Offset Count							
7	Reserved							
	0	0	0	0	0	0	0	0
8	Write Retry Count							
9	Reserved							
	0	0	0	0	0	0	0	0
10	Recovery Time Limit (MSB)							
11	Recovery Time Limit (LSB)							

ARRE, TB, RC and DCR bits in error recovery flag (byte 2) are applied to the data area of the blocks during Read operation. AWRE is applied to the data area of the blocks during Write operation. PER and DTE are applied to errors occurred during read, write or seek operation. EER is ignored.

Bit 7 : AWRE (Automatic Write Reallocation for defective data blocks Enabled)
When set to one , allows the controller to automatically relocate bad blocks detected during write operations.
This function is applied to WRITE, WRITE EXTENDED command but not applied to FORMAT UNIT command.

The drive performs automatic reallocation upon the abnormal termination of write operation after the drive proceeds error recovery process which is specified by mode select.
The drive shall create CHECK CONDITION status with sense key of MEDIUM ERROR when the drive fails to do automatic reallocation.
When set to 0, this bit indicates that the controller does not perform automatic reallocation of defective data blocks during write operations.

Bit 6 : ARRE (Automatic Read Reallocation for defective data blocks Enabled)
When set to one, allows the controller to automatically relocate bad blocks detected during read operations.
This function is applied to READ, READ EXTENDED command.
The drive performs automatic reallocation if the data recovery has been done normally after the drive proceeds error recovery process which is specified by mode select.
The drive shall create CHECK CONDITION status with sense key of MEDIUM ERROR when the drive fails to do automatic reallocation.
When set to 0, this bit indicates that the controller does not perform automatic reallocation of defective data blocks during read operations.

Bit 5 : TB (Transfer Block)
When set to 1, this bit specifies that the data in the error block (recoverable or unrecoverable) is to be transferred to the host computer.
When this bit is set to 0, it specifies that the error block data is not to be transferred to the host computer.

Note : In either case, the information byte area of the sense data is loaded with the error block address.

Bit 4 : RC (Read Continuous)
When set to 1, this bit specifies that the controller is to transfer the entire requested length of data without attempting an error recovery procedure. The controller may send data which may be fabricated (e.g., garbage data in the buffer) to maintain a continuous flow of data. This bit is given precedence over the other bits in this byte.
When this bit is set to 0, it indicates that error recovery operations which cause reasonable delays are acceptable during the data transfer.

MODE SELECT:(15h)

Bit 3 : EER (Enable Early Recovery)
When set to 1, this bit specifies that the controller is to attempt error correction, if possible, before applying retries.
When this bit is set to 0, it specifies that the controller is to carry out the predetermined number of retries before attempting error correction.

Bit 2 : PER (Post Error)
When set to 1, this bit specifies that the controller is to enable the reporting of the CHECK CONDITION status with the RECOVERED ERROR sense key.
When this bit is set to 0, it specifies that the controller does not set the CHECK CONDITION status for RECOVERED ERROR.

Bit 1 : DTE (Disable Transfer on Error)
When set to 1, this bit specifies that the controller is to create the CHECK CONDITION status upon detection of the first error block, irrespective of whether the error is recoverable or not.
When this bit is set to 0, it indicates that the controller can continue transferring the recovered data to the host computer until an unrecoverable error occurs or the specified length of data bytes to be transferred have exhausted.

Bit 0 : DCR (Disable Correction)
When set to 1, this bit specifies that the controller must not attempt error correction during the error recovery procedure.
When this bit is set to 0, it indicates that the controller can attempt error correction during the error recovery procedure.

Combinations of error control bits (bits 0-3) are summarized in Table 5.41.
There are some bit combinations that are not allowed.

Table 5.41 Error Control Bit Combinations

3 EER	2 PER	1 DTE	0 DCR	Description
0	0	0	0	- Retries then correction are attempted (EER & DCR off). - Recovered data are transferred to the host computer with no CHECK CONDITION status (PER off). Data transfer stops only when an unrecoverable error is encountered, in which case the CHECK CONDITION status is created. - The transfer of unrecoverable data block depends on the setting of the TB bit.
0	0	0	1	- Same as (0000) above but no correction applied (DCR on).
0	0	1	0	- Invalid request (DTE on, PER off)
0	0	1	1	- Invalid request (DTE on, PER off)
0	1	0	0	- Same as (0000) above except that the last recovered block is reported with RECOVERED ERROR sense key (PER on) at the end of the data transfer if a recoverable error occurs.
0	1	0	1	- Same as (0100) above but no correction applied (DCR on).
0	1	1	0	- Retries then correction are attempted (EER & DCR off) on first error. Transfer is then stopped (DTE on). - The controller creates the CHECK CONDITION status with RECOVERED ERROR sense key (PER on) if the error is corrected. The CHECK CONDITION status is also created if the error is unrecoverable. - Transfer of the recovered or unrecovered block depends on the setting of the TB bit. Note : It is recommended that this mode be used with the TB bit set on.
0	1	1	1	- Same as (0110) above but no correction applied (DCR on).
1	0	0	0	- Same as (0000) above except that correction is applied first (EER on, DCR off).
1	0	0	1	- Invalid request (EER on, DCR on)
1	0	1	0	- Invalid request (PER off, DTE on)

(cont'd)

MODE SELECT:(15h)

Table 5.41 Error Control Bit Combinations (cont'd)

1	0	1	1	- Invalid request (EER on, DCR on) (PER off, DTE on)
1	1	0	0	- Same as (0100) above except that correction is applied first (EER on, DCR off).
1	1	0	1	- Invalid request (EER on, DCR on)
1	1	1	0	- Same as (0110) above except that correction is applied first (EER on, DCR off).
1	1	1	1	- Invalid request (EER on, DCR on)

Read Retry Count and Write Retry Count specify the host permissible retry counts for an error recovery operations executed by the controller.
The controller retries within these retry counts specified by the host computer.
Retry count 0 indicates that the host permissible error recovery operations are not executed, The error correction by ECC and the host impermissible recovery operations, however, may be executed if it is permitted.

The correction Span specifies the maximum error bits span to be corrected by the controller.
The controller corrects an ECC error within the specified maximum error bits span, if the error correction is permitted.

Head Offset Count specifies the offset value of the head position from the center of track. (Count value range ; FE_H to 02_H = -2 to +2, + ; offset toward the inner periphery.)
The controller executes the head offset as the specified count value.
The controller will change the offset value depending on the retry count in the error retry

sequence. (See 2.3.1). After the retry operation, the offset is returned to the Count value. When the write operation is executed, the offset is always returned to 0.

Data Strobe Offset Count specifies the offset value of the data strobing level from the standard level. (Count value range ; FE_H to 02_H = -2 to +2)
The controller will change the offset value depending on the retry count in the error retry sequence. (See 2.3.1) After the retry operation, the offset is returned to the Count value. When the write operation is executed, the offset is always returned to 0.

MODE SELECT:(15h)

Recovery Time Limit specifies the time limit in 1ms increments, in which the controller can execute the data error retrials.
The controller attempts the error recovery operation per command, within the shorter time either of the Retry Count or the Recovery Time Limit.
There is the case that the time out is held pending until one operation finishes even if the time out is detected after starting error recovery operation. In this case, the actual time limit sometimes exceeds the time limit specified by the host computer.
If the Recovery Time Limit is set to 0000_H, the controller shall use its default value.
If the Recovery Time Limit is set to $FFFF_H$, the controller waits until the recovery operation has terminated.

[Mode Page 2_H]

Table 5.42 Disconnect - Reconnect Page (Page Code = 2_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved 0	SPF 0	Page Code(02_H) 0	0	0	0	1	0
1	Page Length($0E_H$) 0	0	0	0	1	1	1	0
2	Bus Full Ratio							
3	Buffer Empty Ratio							
4	Bus Inactivity Limit (MSB)							
5	Bus Inactivity Limit (LSB)							
6	Disconnect Time Limit (MSB)							
7	Disconnect Time Limit (LSB)							
8	Connect Time Limit (MSB)							
9	Connect Time Limit (LSB)							
10	Maximum Burst Size (MSB) 0	0	0	0	0	0	0	0
11	Maximum Burst Size (LSB) 0	0	0	0	0	0	0	0
12	Reserved 0	Fair Arbitration			DIMM	DTDC		
13	Reserved 0	0	0	0	0	0	0	0
14	Reserved 0	0	0	0	0	0	0	0
15	Reserved 0	0	0	0	0	0	0	0

Buffer Full Ratio and Buffer Empty Ratio parameters are the numerator of a fractional multiplier that has 256 as its denominator and these parameters indicate the full or empty ratio of buffer.

MODE SELECT:(15h)

The controller calculates the timing to be considered as Buffer Full / Empty in the number of blocks based on the specified ratio, the transfer data size and the buffer size.

Buffer Full Ratio specifies the amount of data considered as Buffer Full during the READ operation, and the controller uses it as a timing of reconnection for data transfer to the host computer.
The controller uses the value which is rounded down in the number of blocks based on the ratio.
If Buffer Full Ratio is set to 0, the controller considers as Buffer Full when the first block to be read is detected.
Further, the controller gives priority to the internal algorithm irrespective of the value specified in the Buffer Full Ratio.

The Buffer Empty Ratio specifies the amount of written data considered as Buffer Empty during the WRITE operation, and the controller uses it as a timing of reconnection for data transfer from the host computer.
The controller uses the value which is rounded down in the number of blocks based on the ratio.
If Buffer Empty Ratio is set to 0, the controller considers as Buffer Empty when the first block to be written is detected.
The controller uses this parameter when the reconnection is attempted for data transfer after the disconnection caused by Buffer Full, then this parameter is effective when the amount of transfer data exceeds the buffer size. However, when the data transfer from the host computer and the write operation to the disk drive are overlapped, this parameter may not be used even if the amount of transfer data exceeds the buffer size.
Further, the controller gives priority to the internal algorithm irrespective of the value specified in the Buffer Empty Ratio.

Bus Inactivity Limit is specified by the host computer as the maximum time in 100 micro seconds increments which the controller is allowed to maintain the bus busy without handshaking until it shall disconnect.
Bus Inactivity Limit of 0 shows that there is no limit in time.
The controller supports Bus Inactivity Limit = 0 only.

Disconnect Time Limit is specified by the host computer as the minimum time in 100 micro seconds increments which the controller continues disconnection until reconnection is initiated.
Disconnect Time Limit of 0 shows that there is no limit in time.
This field needs to be always specified to 0 as the controller does not support this field.

MODE SELECT:(15h)

Connect Time Limit is specified by the host computer the maximum time in 100 micro seconds increments which the controller continues connection until disconnection is initiated.
Connect Time Limit of 0 shows that there is no limit in time.
This field needs to be always specified to 0 as the controller does not support this field.

Maximum Burst Size is specified by the host computer the maximum data amount in bytes, in 512 bytes increments, which the controller can transfer per each connection. (Note : the count one represents 512 bytes.) When the specified data amount has transferred, the controller disconnects. This field of zero indicates there is no limitation with the transfer size per connection. This field needs to be always specified to 0 as the controller does not support this field.

Fair Arbitration is specified whether SCSI bus fairness function.
Fair Arbitration of 000b indicates the controller does not perform SCSI bus fairness function.
Fair Arbitration of 001b indicates the controller perform SCSI bus fairness function.
When specified expect 000b and 001b as Fair Arbitration, let the controller be CHECK CONDITION status by ILLEGAL REQUEST sense key.

DTDC (Data Transfer Disconnect Control) is specified by the host computer as the conditions that control SCSI bus disconnect.

Table 5.43 DTDC (Data Transfer Disconnect Control)

Bit 2 ,1, 0	Disconnect Control
000	Disconnect control is not implemented. Disconnection is controlled by the other field in this page.
001	No disconnection is executed for the period starting the command transfer over the full data transfer. Connect Time Limit and Bus Inactivity Limit are ignored during the data transfer.
010	Reserved
011	No disconnection is executed for the period starting the command transfer, until the command completed. Connect Time Limit and Bus Inactivity Limit are ignored after the data transfer started.
1XX	Reserved

Note: X denotes a don't care condition.

MODE SELECT:(15h)

DIMM (Disconnect Immediate) is specified by the host computer whether or not the controller disconnects the SCSI bus until the data transfer is initiated after receiving the command from the host.
DIMM of 1 indicates the controller disconnects after receiving the command (if it is allowed by other parameters).
DIMM of 0 indicates the controller itself determines whether it disconnects or not.

[Mode Page 3_H]

Table 5.44 Format Device Page (Page Code = 3_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(03_H)					
	0	0	0	0	0	0	1	1
1	Page Length(16_H)							
	0	0	0	1	0	1	1	0
HANDLING OF DEFECTS FIELDS								
2	Tracks per Zone (MSB)							
3	Tracks per Zone (LSB)							
4	Alternate Sectors per Zone (MSB)							
5	Alternate Sectors per Zone (LSB)							
6	Alternate Tracks per Zone (MSB)							
7	Alternate Tracks per Zone (LSB)							
8	Alternate Tracks per Logical Unit (MSB)							
9	Alternate Tracks per Logical Unit (LSB)							
TRACK FORMAT FIELD								
10	Sector per Track (MSB)							
11	Sector per Track (LSB)							

(cont`d)

Table 5.44 Format Device Page (Page Code = 3_H) (Cont`d)

SECTOR FORMAT FIELDS								
12	Data Bytes per Physical Sector (MSB)							
13	Data Bytes per Physical Sector (LSB)							
14	Interleave (MSB) (00_H)							
	0	0	0	0	0	0	0	0
15	Interleave (LSB) (01_H)							
	0	0	0	0	0	0	0	1
16	Track Skew Factor (MSB)							
17	Track Skew Factor (LSB)							
18	Cylinder Skew Factor (MSB)							
19	Cylinder Skew Factor (LSB)							
DRIVE TYPE FIELD								
20	SSEC	HSEC	RMB	SURF	Reserved			
	0		0	0	0	0	0	0
21	Reserved							
	0	0	0	0	0	0	0	0
22	Reserved							
	0	0	0	0	0	0	0	0
23	Reserved							
	0	0	0	0	0	0	0	0

The following information should be sent to the controller prior to the execution of the FORMAT UNIT command.

After changing these parameters, a FORMAT UNIT command must be sent for the changes to take effect.

< Handling of defects fields >
The Tracks per Zone field specifies the size in tracks of the zone for the purpose of allocating alternate spare sectors in zones. The host computer must set this field to 1.

The Alternate Sector per Zone field specifies the number of sectors that the controller reallocates from the host computer addressable blocks during the execution of FORMAT UNIT command. The controller can use these sectors as alternate spare sectors for defective sectors.

The Alternate Tracks per Zone field specifies the number of tracks that the controller reallocates from the host computer addressable blocks during the FORMAT UNIT command. The host computer must always set this field to 0.

The Alternate Tracks per Logical Unit field specifies the number of tracks per volume (logical unit) that the controller reallocates from the host computer addressable blocks during the FORMAT UNIT command. The controller can use these tracks as alternate spare sectors for defective sectors.

< Track Format Field >
Sectors per Track specifies the number of physical sectors that the controller is to allocate per disk track. The controller calculates this value automatically from the data bytes per physical sector and allocates the equal number of sectors per each track. The controller ignores the value by the host computer in this field.

< Sector Format Field >
Data Byte per Physical Sector specifies the number of data bytes that the controller is to allocate per physical sector. This value must agree with the value for Block Length in the Block Descriptor (if used) of the MODE SELECT command. If the value is different , the value indicated in the Block Descriptor will be used.

The Interleave field requests that the logical blocks are related in a specific manner to physical blocks to facilitate speed matching between the host bus data transfer rate and the block data transfer rate of the device.
This controller supports sector Interleave factor (n=1) only.

Track Skew Factor specifies the number of physical sectors between the last logical block of one track and the first logical block on the next sequential track of the same cylinder.

Cylinder Skew Factor specifies the number of physical sectors between the last logical block of one cylinder and the first logical block of the next sequential cylinder.

When this value is specified as the one cylinder seeking time, continuous blocks over two cylinders can be accessed with minimum rotational latency.

MODE SELECT:(15h)

< Drive Type Field >
The SSEC (Soft Sector) bit set to 1 specifies that the controller is to use soft sector formatting. Since this SCSI controller does not support soft sector formatting, the host computer must always set this bit to 0.

The HSEC (Hard Sector) bit set to 1 specifies that the controller is to use hard sector formatting. This SCSI controller always uses hard sector formatting. If HSEC is set to 0, the controller ignores this value.

The RMB (Removable) bit set to 1 indicates that the logical unit is removable. Since these disk drives are not removable, the host computer must always set this bit to 0.

The SURF (Surface) bit set to 1 specifies how the controller is to map the logical block addressing into physical block addressing. The host computer must always set this bit to 0.
This bit = 0 specifies that the controller is to allocate progressive addresses to all sectors on a cylinder prior to allocating sector addresses to the next cylinder.

[Mode Page 4_H]

Table 5.45 Rigid Disk Geometry Page (Page Code = 4_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(04_H)					
	0	0	0	0	0	1	0	0
1	Page Length(16_H)							
	0	0	0	1	0	1	1	0
2	Number of Cylinders (MSB)							
3	Number of Cylinders							
4	Number of Cylinders (LSB)							
5	Number of Heads							

(cont`d)

Table 5.45 Rigid Disk Geometry Page (Page Code = 4_H) (cont`d)

6	Starting Cylinder - Write Precompensation (MSB)							
	0	0	0	0	0	0	0	0
7	Starting Cylinder - Write Precompensation							
	0	0	0	0	0	0	0	0
8	Starting Cylinder - Write Precompensation (LSB)							
	0	0	0	0	0	0	0	0
9	Starting Cylinder - Reduced Write Current (MSB)							
	0	0	0	0	0	0	0	0
10	Starting Cylinder - Reduced Write Current							
	0	0	0	0	0	0	0	0
11	Starting Cylinder - Reduced Write Current (LSB)							
	0	0	0	0	0	0	0	0
12	Drive Step Rate (MSB)							
	0	0	0	0	0	0	0	0
13	Drive Step Rate (LSB)							
	0	0	0	0	0	0	0	0
14	Landing Zone Cylinder (MSB)							
	0	0	0	0	0	0	0	0
15	Landing Zone Cylinder							
	0	0	0	0	0	0	0	0
16	Landing Zone Cylinder (LSB)							
	0	0	0	0	0	0	0	0
17	Reserved						RPL	
	0	0	0	0	0	0	0	0
18	Rotational Offset							
	0	0	0	0	0	0	0	0
19	Reserved							
	0	0	0	0	0	0	0	0
20	Medium Rotation Rate (MSB)							
21	Medium Rotation Rate (LSB)							
22	Reserved							
	0	0	0	0	0	0	0	0
23	Reserved							
	0	0	0	0	0	0	0	0

Number of Cylinders and Number of Heads specify number of cylinders and heads in logical unit. Initiator should be set these fields to the values up to the physical numbers of cylinders and heads in the logical unit.

MODE SELECT:(15h)

Starting Cylinder-Write Precompensation specifies the starting cylinder of the write data peak shift precompensation. Since the disk drives controlled by the controller need not to precompensate the write data peak shift, there should be 0_H.

Starting Cylinder-Reduced Write Current specifies the starting cylinder of the reducing write current.
Since the disk drives controlled by the controller need not to change write current at any cylinder boundary, this field need not be specified and there should be 0_H.

Drive Step Rate specifies the step rate of the step motor for head seeking. Since the disk drives controlled by the controller use a voice coil motor, this field need not be specified and there should be 0_H.

Landing Zone Cylinder specifies the heads positioning cylinder number when spindle motor is stopped.

Since the disk drives controlled by the controller automatically move the heads to the landing zone when spindle motor is stopped, this field need not be specified and there should be 0_H.

RPL (Rotational Position Locking) field specifies the control of the Spindle Synchronization.
This value should be 00_H since the disk drive does not support the Spindle Synchronization function.

Rotational Offset field specifies the rotational skew that slave shall apply in synchronizing to the external SLAVE SYNC signal.
This value should be 00_H since the disk drive does not support the Rotational Offset function.

Medium Rotation Rate indicates the disk rotation rate in rpm.

MODE SELECT:(15h)

[Mode Page 7_H]

Table 5.46 Verify Error Recovery Page (Page Code = 7_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(07_H)					
	0	0	0	0	0	1	1	1
1	Page Length($0A_H$)							
	0	0	0	0	1	0	1	0
2	Reserved				EER	PER	DTE	DCR
	0	0	0	0				
3	Verify Retry Count							
4	Verify Correction Span							
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Reserved							
	0	0	0	0	0	0	0	0
8	Reserved							
	0	0	0	0	0	0	0	0
9	Reserved							
	0	0	0	0	0	0	0	0
10	Verify Recovery Time Limit (MSB)							
11	Verify Recovery Time Limit (LSB)							

This page specifies the error recovery parameters the controller shall use during the verify operation of the VERIFY command and the WRITE AND VERIFY command.

The EER, PER, DTE and DCR bits are defined in the descriptions preceded by Table 5.40. The combinations of these bits are defined in Table 5.41.
The Verify Retry Count, Verify Correction Span and Verify Recovery Time Limit are also similarly defined except that these are used at the verify operation.

The automatic reallocation is not applied to the WRITE AND VERIFY command and the VERIFY command execution.

MODE SELECT:(15h)

[Mode Page 8_H]

Table 5.47 Caching Page (Page Code = 8_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved 0	SPF 0	Page Code(08_H) 0	0	1	0	0	0
1	Page Length(12_H) 0	0	0	1	0	0	1	0
2	IC	R 0	CAP	DISC	SIZE	WCE	MF	RCD
3	Demand Read Retention Priority 0	0	0	0	Write Retention Priority 0	0	0	0
4	Disable Pre-fetch Transfer Length (MSB)							
5	Disable Pre-fetch Transfer Length (LSB)							
6	Minimum Pre-fetch (MSB)							
7	Minimum Pre-fetch (LSB)							
8	Maximum Pre-fetch (MSB)							
9	Maximum Pre-fetch (LSB)							
10	Maximum Pre-fetch Ceiling (MSB)							
11	Maximum Pre-fetch Ceiling (LSB)							
12	FSW 0	LBCSS	DRA	Reserved 0	0	0	0	0
13	Number of Cache Segments							
14	Cache Segment Size(MSB)							
15	Cache Segment Size(LSB)							
16	Reserved 0	0	0	0	0	0	0	0
17	Reserved 0	0	0	0	0	0	0	0
18	Reserved 0	0	0	0	0	0	0	0
19	Reserved 0	0	0	0	0	0	0	0

MODE SELECT:(15h)

Caching Page is specified to control look ahead caching.

A IC(Initiator Control) bit of one indicates that controller use the number of cache segments or cache segment size fields, dependent upon the SIZE bit, to control the caching algorithm rather than the controller own adaptive algorithm.
Since the controller does not support IC bit, this bit is ignored.

A CAP(Caching Analysis Permitted) bit of one indicates that the controller perform caching analysis during subsequent operations. When zero, CAP requests that caching analysis be disabled to reduce overhead time or to prevent nonpertinent operations from impacting tuning values.
Since the controller does not support CAP bit, this bit is ignore.

A DISC(Discontinuity) bit of one indicates that the controller continue the pre-fetch across time discontinuities (such as across cylinders, up to the limit of the segment, space available for the pre-fetch).
A DISC bit of zero indicates that the controller truncates the pre-fetches at time discontinuities.
Since the controller does not support DISC bit, this bit is ignored.

A SIZE(Size Enable) bit of one indicates that the Cache Segment Size is to be used to control caching segmentation.

A SIZE bit of zero indicates that the Number of Cache Segments is to be used to control caching segmentation.

WCE (Write Cable Enable) bit specifies the timing to inform the GOOD status for WRITE command.
A WCE bit of one indicates that the controller may return GOOD status after successfully storing all of the data in the cache before having successfully written them the media.
A WCE bit of zero indicates that the controller returns GOOD status after all of data has been written to the media.

MF (Multiplication Factor) bit specifies the interpretation of the minimum and maximum Pre-fetch field.
A MF bit of zero indicates that the controller shall interpret these fields in terms of the number of logical blocks for the pre-fetch.
A MF bit of one indicates that the controller shall interpret these fields in terms of a scalar number which, when multiplied by the number of logical blocks to be transferred (transfer length) for the current command, yields the number of logical blocks for the pre-fetch.
Since the controller does not support MF bit, there should be 0_H.

MODE SELECT:(15h)

A RCD (Read Cache Disable) bit of zero indicates that the controller may return data requested by a READ command by accessing either the cache or media (if the requested data has not been cached yet).
A RCD bit of one indicates that the controller shall transfer all requested data by accessing the media without using pre-fetched data.
When RCD bit is set to 1, the data pre-fetched before becomes invalid.

Demand Read Retention Priority specifies the priority of a read data to be retained in the cache after the read data has transferred to the host computer yet.
Since the controller does not support this field, there should be 0_H.

Write Retention Priority specifies the priority of a write data to be retained in the cache after the write data has written into the media yet.
Since the controller does not support this field, there should be 0_H.

Disable Pre-fetch Transfer Length specifies maximum data block number to be pre-fetched. If the data block number requested by a READ command is greater than the number specified in this field, the surpassed number of blocks will not be pre-fetched.
If this field is set to 0_H, the pre-fetch will not be executed.

Minimum Pre-fetch specifies the minimum number of data to be pre-fetched prior to executing subsequent commands.
The subsequent commands shall be waited to execute till the number of data specified in this field will have been pre-fetched.

Maximum Pre-fetch specifies the maximum number of data to be pre-fetched if there is no subsequent commands.
The data number to be pre-fetched is specified is MF field as either a number of blocks or a scalar multiplier of the transfer length.
If the data block number requested is greater than the cache (segment) size, the controller will pre-fetch the partial data which is the full size of cache (segment) and will not pre-fetch the surpassed data.
Maximum Pre-fetch value shall be equal to or greater than Minimum Pre-fetch value.
However, the maximum pre-fetch count is determined by the segment size because the controller uses cache memory divided into segments.

Note : When the error occurs during pre-fetching, the controller will stop pre-fetching. This case is not regarded as the error to be informed to the host.

Maximum Pre-fetch Ceiling specifies an upper limit on the number of logical blocks computed from the Maximum Pre-fetch.

MODE SELECT:(15h)

If this number of blocks is greater than the Maximum Pre-fetch Ceiling, then the number of logical blocks maximally pre-fetched shall be truncated to the value stored in the Maximum Pre-fetch Ceiling field.

A FSW(Force Sequential Write) bit of one indicates that the controller writes the multiple block writes to the media in an ascending, sequential, logical block order. A FSW bit of zero indicates that the controller reorders the sequence of writing addressed logical blocks in order to achieve a faster command completion.
Since the controller does not support FSW bit, this bit is ignored.

The Disable Read-Ahead(DRA) bit, when one, requests that the device server not read into the buffer any logical blocks beyond the addressed logical block(s). When the DRA bit equals zero, the device server may continue to read logical blocks into the buffer beyond the addressed logical block(s).

The Logical Block Cache Segment Size(LBCSS) bit when one, indicates that the Cache Segment Size field units shall be interpreted as logical blocks. When the LBCSS bit equals zero the Cache Segment Size field units shall be interpreted as butes. The LBCSS shall not impact the units of other field.

The Number of Cache segment specifies how many segments the host requests that the cache be divided into.

The Cache Segment Size field indicates the requested segment size in bytes. This standard defines that the Cache Segment Size field is valid only when SIZE bit is one.

[Mode Page A_H]

Table 5.48 Control Mode Page (Page Code = A_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code($0A_H$)					
	0	0	0	0	1	0	1	0
1	Page Length($0A_H$)							
	0	0	0	0	1	0	1	0
2	Reserved						GLTSD	RLEC
	0	0	0	0	0	0		0

(cont'd)

MODE SELECT:(15h)

Table 5.48 Control Mode Page (Page Code = AH) (cont'd)

3	Queue Algorithm Modifier				Reserved		QErr	DQue
					0	0		
4	EECA	Reserved				RAENP	UAAENP	EAENP
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Ready AEN Holdoff Period (MSB)							
	0	0	0	0	0	0	0	0
7	Ready AEN Holdoff Period (LSB)							
	0	0	0	0	0	0	0	0
8	Busy Timeout Period(MSB)							
9	Busy Timeout Period(LSB)							
10	Extended Self-Test Completion Time(MSB)							
11	Extended Self-Test Completion Time(LSB)							

The GLTSD (Global Logging Target Save Disable) bit of zero allows the controller to provide the controller-defined method for saving log parameters. The GLTSD bit of one indicates that either the controller has disabled the controller-defined method for saving log parameters or when set by the host computer specifies that the controller-defined method shall be disabled.

The RLEC (Report Log Exception Condition) bit field specifies whether or not the controller will report a log exception condition.
The controller does not support the RLEC bit.

The Queue Algorithm Modifier specifies the execution order of commands with Simple Queue Tag message.

Value	Description
0_H	Restricted re-ordering
1_H	Unrestricted re-ordering allowed

A value of zero in the Queue Algorithm Modifier field specifies that the device server shall order the processing sequence of tasks having the SIMPLE task attribute such that data integrity is maintained for that initiator.

MODE SELECT:(15h)

This means that, if the transmission of new service delivery requests is halted at any time, the final value of all data observable on the medium shall have exactly the same value as it would have if all the tasks had been given the ORDERED task attribute.

The restricted reordering value shall be the default value. A value of one in the Queue Algorithm Modifier field specifies that the device server may reorder the processing sequence of tasks having the SIMPLE task attribute in any manner.
Any data integrity exposures related to task sequence order shall be explicity handled by the application client through the selection of appropriate commands and task attributes.

The QErr (Queue Error Management) bit of 0 indicates that the controller will continue normally the subsequent processing of the queued command, that is queued after either a contingent allegiance condition or an extended contingent allegiance condition occurred with the current command and then after such a condition is terminated.
The QErr bit of 1 indicates that the controller will halt the processing of queued command at the termination of such a condition. And all but the initiator which issued first the Initiate Recovery message will be returned the UNIT ATTENTION condition with an additional sense code of TAGGED COMMAND CLEARED BY ANOTHER INITIATOR.

The DQue (Disable Queuing) bit of 0 indicates that the tagged command queuing is supported. The DQue bit of 1 indicates that the tagged command queuing is not supported. All queued commands with respect to the I-T-X nexus will not be executed. A queue tag command is terminated with CHECK CONDITION status and INVALID MESSAGE ERROR additional sense code.

The EECA (Enable Extended Contingent Allegiance) bit of 0 indicates that the extended contingent allegiance condition is not supported to occur. The EECA bit of 1 indicates that the ECA condition is supported.
The controller does not accept the ECA condition.

The RAENP (Ready AEN Permission) bit of 0 indicates that the controller shall not report an UNIT ATTENTION condition by AEN (Asynchronous Event Notification) after power-on or reset sequence. The RAENP bit of 1 indicates that such a report is permissible.
The controller does not report an UNIT ATTENTION condition by AEN after power-on or reset sequence.

The UAAENP (Unit Attention AEN Permission) bit of 0 indicates that the controller shall not report an UNIT ATTENTION condition by AEN which occurs except after power-on or reset sequence. The UAAENP bit of 1 indicates that such a report is permissible.

MODE SELECT:(15h)

The controller does not report an UNIT ATTENTION condition by AEN after power-on or reset sequence.

The EAENP (Error AEN Permission) bit of 0 indicates that the controller shall not report it by AEN when a deferred error is detected. The EAENP bit of 1 indicates that such a report is permissible.
The controller does not report a Deferred Error by AEN.

The Read AEN Holdoff Period specifies the minimum delay time in milliseconds (ms) from the controller initiated a power-on or reset sequence till issuing a report by AEN.

The controller does not support Ready AEN Holdoff Period specification.

The Busy Timeout Period field specifies the maximum time, in 100 milliseconds increments, that the initiator allows for the target to remain busy for unanticipated conditions which are not a routine part of commands from the initiator. A 0000_H value in this field is undefined by this standard. An $FFFF_H$ value in this field is defined as an unlimited period.

The Extended Self-Test Completion Time field contains advisory data that an application client may use to determine the time in seconds that the device server requires to complete an extended self-test when the device server is not interrupted by subsequent commands and no errors occur during excecution of the self-test. The application client should expect this time to increase significantly if other commands are sent to the logical unit while a self-test is in progress or it errors occur during excecution of the self-test. Device servers supporting Self-Test Code field values other than (000)b for the SEND DIAGNOSTIC command(see 5.29), shall support the Extended Self-Test Completion Time field.

[Mode Page C_H]

Table 5.49 Notch and Partition Page (Page Code = C_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code($0C_H$)					
	0	0	0	0	1	1	0	0
1	Page Length(16_H)							
	0	0	0	1	0	1	1	0
2	ND	LPN	Reserved					
	1		0	0	0	0	0	0

(cont'd)

MODE SELECT:(15h)

Table 5.49 Notch and Partition Page (Page Code = CH) (cont'd)

3	Reserved							
	0	0	0	0	0	0	0	0
4	Maximum Number of Notches (MSB)							
5	Maximum Number of Notches (LSB)							
6	Active Notch (MSB)							
7	Active Notch (LSB)							
8 | 11	Starting Boundary (MSB)							
	Starting Boundary (LSB)							
12 | 15	Ending Boundary (MSB)							
	Ending Boundary (LSB)							
16 | 23	Pages Notched (MSB)							
	Pages Notched (LSB)							

This page specifies the parameters for direct-access devices supporting a variable number of blocks per cylinder. Each section of the drive with a different number of blocks per cylinder is referred to as a Notch. Each Notch will span a set of consecutive logical blocks on the logical drive. The Notches will not overlap, and no logical block will be excluded from a Notch.

The ND (Notched Drive) bit specifies whether or not the drive is notched. A ND bit of 0 indicates that the device is not notched and that all other parameters in this page shall be returned as zero by the controller. A ND bit of 1 indicates that the device is notched. For each supported active notch value, this page defines the starting and ending boundaries of the notch.
In case of ND = 1, the following description for the Maximum Number of Notches, Active Notch, Starting Boundary, Ending Boundary and Pages Notched is applied.

The LPN (Logical or Physical Notch) bit specifies whether the Starting Boundary and the Ending Boundary fields reported by the MODE SENSE command indicates physical parameter(cylinder number and head number) or logical block address.

When the LPN bit is set to 0, the boundaries indicate physical parameter.
When the LPN bit is set to 1, the boundaries indicate logical block address.
Since the controller supports only the Cylinder & Head number format, LPN bit should be set to 0_H.

The Maximum Number of Notched field indicates the number of notches supported by the drive.

The Active Notch field indicates the notch(1 through n, n: number of notches) referred to by the current and subsequent MODE SELECT / MODE SENSE command. When this field is zero, the parameters of current and subsequent MODE SELECT/ MODE SENSE command is applied across all notches.

The Starting Boundary field indicates the beginning of the notch specified in the Active Notch field. The three most significant bytes of this field represent the cylinder number and the least significant bytes represent the head number.

The Ending Boundary field indicates the ending of the notch specified in the Active Notch field. The three most significant bytes of this field represent the cylinder number and the least significant byte represents the head number.

The values of the Starting Boundary and the Ending Boundary field specified by the MODE SELECT command are ignored.

The Pages Notched field contains the bit map information of mode pages of which parameters may be different for different notches. The most significant bit of this field corresponds to mode page code $(3F)_H$, and the least significant bit of this field corresponds to mode page code $(00)_H$.

[Mode Page 18_H]

Table 5.50 Logical Unit Control Page (Page Code = 18_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(18_H)					
	0	0	0	1	1	0	0	0
1	Page Length							
	0	0	0	0	0	1	1	0
2	Reserved				Protocol Identifier			
	0	0	0	0	0	0	0	1
3	Reserved							
	0	0	0	0	0	0	0	0

(cont'd)

Table 5.50 Logical Unit Control Page (Page Code = 18H) (cont'd)

4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Reserved							
	0	0	0	0	0	0	0	0

The logical unit control page contains those parameters that select logical unit operation options.

The protocol identifier of 1h indicates the protocol that this mode page applies to a SPI SCSI device.

[Mode Page 19_H]

Table 5.51 Port Control Page (Page Code = 19_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(19_H)					
	0	0	0	1	1	0	0	1
1	Page Length							
	0	0	0	0	0	1	1	0
2	Reserved				Protocol Identifier			
	0	0	0	0	0	0	0	1
3	Reserved							
	0	0	0	0	0	0	0	0
4	Synchronous Transfer Timeout(MSB)							
5	Synchronous Transfer Timeout(LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Reserved							
	0	0	0	0	0	0	0	0

The port control page contains those parameters that affect SCSI port operation options. The page shall be implemented by LUN 0 of all SPI SCSI target devices.

The page shall not be implemented by logical units other than LUN 0. The implementation of any bit and its associated functions is optional.

The protocol identifier of 1h indicates the protocol that this mode page applies to a SPI SCSI device.

The synchronous transfer timeout field indicates the maximum amount of time in 1 ms increments that the controller shall wait before generating an error by doing an unexpected bus free.
The controller shall only go to a BUS FREE phase if one of the following events causes the timer, once started, to not reset or reload before expiring.

a) If there is a REQ transition when there are no outstanding REQs waiting for an ACK then load and start the timer.

b) If there is a REQ transition when there are any outstanding REQs waiting for an ACK then there is no effect on the timer.

c) If there is an ACK transition when there are outstanding REQs waiting for an ACK then load and start the timer.

d) If after an ACK transition there are no outstanding REQs waiting for an ACK then stop the timer.

A synchronous transfer timeout field value of 0000_H indicates that the function is disabled. A value of $FFFF_H$ indicates an unlimited period.

[Mode Page 19_H Sub Page 01_H]

Table 5.52 Margin Control Sub Page (Page Code = 19_H, Sub Page Code = 01_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(19_H)					
	0	1	0	1	1	0	0	1
1	Sub Page Code(01_H)							
	0	0	0	0	0	0	0	1
2	Page Length(MSB)							
	0	0	0	0	0	0	0	0
3	Page Length(LSB)							
	0	0	0	1	0	0	1	0

(cont'd)

MODE SELECT:(15h)

Table 5.52 Margin Control Sub Page (Page Code = 19H, Sub Page Code = 01H) (cont'd)

4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved				Protocol Identifier			
	0	0	0	0	0	0	0	1
6	Reserved							
	0	0	0	0	0	0	0	0
7	Driver Strength				Reserved			
					0	0	0	0
8	Driver Asymmetry				Driver Precompensation			
9	Driver Slew Rate				Reserved			
					0	0	0	0
10	Reserved							
	0	0	0	0	0	0	0	0
11	Reserved							
	0	0	0	0	0	0	0	0
12	Reserved							
	0	0	0	0	0	0	0	0
13	Vendor Specification							
	0	0	0	0	0	0	0	0
14	Reserved							
	0	0	0	0	0	0	0	0
15	Reserved							
	0	0	0	0	0	0	0	0
16	Reserved							
	0	0	0	0	0	0	0	0
17	Reserved							
	0	0	0	0	0	0	0	0
18	Reserved							
	0	0	0	0	0	0	0	0
19	Reserved							
	0	0	0	0	0	0	0	0
20	Reserved							
	0	0	0	0	0	0	0	0
21	Reserved							
	0	0	0	0	0	0	0	0

The margin control subpage (see Table 5.52) contains parameters that set and report margin control values for usage between the host computer/controller pair on subsequent synchronous and paced transfers.

MODE SELECT:(15h)

The subpage code field indicates which subpage is being accessed. If the Subpage Code field is zero the controller shall return a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN PARAMETER LIST.

The protocol identifier of 1h indicates the protocol that this mode page applies to a SPI SCSI device.

The driver strength field indicates the relative amount of driver source current used by the driver. The driver strength field affects both the strong and weak drives.

The driver precompensation field indicates the relative difference between the weak driver and the strong driver amplitudes when precompensation is enabled. A larger value indicates a larger difference between the weak and strong amplitudes.

The driver asymmentry field indicates the relative difference between the amplitudes of asserted and negated signals launched from the driver. A larger value indicates a relatively stronger asserted signal compared to the negated signal.

The driver slew rate field indicates the relative difference between the assertion and negation magnitudes divided by the rise or fall time. A larger value indicates a faster slew rate.

The default value of each margin control field should be 0000b.

[Mode Page 19_H Sub Page 02_H]

Table 5.53 Saved Training Configuration SubPage (Page Code = 19_H, SubPage Code = 02_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(19_H)					
	0	1	0	1	1	0	0	1
1	Sub Page Code(02_H)							
	0	0	0	0	0	0	1	0
2	Page Length(MSB)							
	0	0	0	0	0	0	0	0
3	Page Length(LSB)							
	1	1	1	0	0	1	1	0

(cont'd)

MODE SELECT:(15h)

Table 5.53 Saved Training Configuration SubPage (Page Code = 19H, SubPage Code = 02H)(cont'd)

4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved				Protocol Identifier			
	0	0	0	0	0	0	0	1
6 – 9	Reserved							
10-13	DB(0) Value							
14-17	DB(1) Value							
18-21	DB(2) Value							
22-25	DB(3) Value							
26-29	DB(4) Value							
30-33	DB(5) Value							
34-37	DB(6) Value							
38-41	DB(7) Value							
42-45	DB(8) Value							
46-49	DB(9) Value							
50-53	DB(10) Value							
54-57	DB(11) Value							
58-61	DB(12) Value							
62-65	DB(13) Value							
66-69	DB(14) Value							
70-73	DB(15) Value							
74-77	P_CRCA Value							
78-81	P1 Value							
82-85	BSY Value							
86-89	SEL Value							
90-93	RST Value							
94-97	REQ Value							
98-101	ACK Value							
102-105	ATN Value							
106-109	C/D Value							
110-113	I/O Value							
114-117	MSG Value							
118-233	Reserved							

The saved training configuration values sub page is used to report the SCSI device's saved training configuration values. These vendor specific values are maintained by the SCSI device when the retain training information option is enabled (see 3.2.3). The fields are listed in Table 5.53however the content of the fields is vendor specific.

MODE SELECT:(15h)

Only values for the current I_T nexus are reported.

The protocol identifier of 1h indicates the protocol that this mode page applies to a SPI SCSI device.

The controller does not support BSY Value, SEL Value, RST Value, ATN Value, C/D Value, I/O Value, and MSG Value.

[Mode Page 19_H Sub Page 03_H]

Table 5.54 Negotiated Setting Sub Page (Page Code = 19_H, Sub Page Code = 03_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved 0	SPF 1	Page Code(19_H) 0	 1	 1	 0	 0	 1
1	Sub Page Code(03_H) 0	 0	 0	 0	 0	 0	 1	 1
2	Page Length(MSB) 0	 0	 0	 0	 0	 0	 0	 0
3	Page Length(LSB) 0	 0	 0	 0	 1	 0	 1	 0
4	Reserved 0	 0	 0	 0	 0	 0	 0	 0
5	Reserved 0	 0	 0	 0	Protocol Identifier 0	 0	 0	 1
6	Transfer Period Factor							
7	Reserved 0	 0	 0	 0	 0	 0	 0	 0
8	REQ/ACK Offset							
9	Transfer Width Exponent							
10	Reserved 0	Protocol Option Bits						
11	Reserved 0	 0	 0	 0	Transceiver Mode		Sent PCOMP_EN	Received PCOMP_EN
12	Reserved 0	 0	 0	 0	 0	 0	 0	 0
13	Reserved 0	 0	 0	 0	 0	 0	 0	 0

MODE SELECT:(15h)

The negotiated settings sub page, shown in Table 5.54, is used to report the negotiated settings of the controller for the current I_T nexus.

The protocol identifier of 1h indicates the protocol that this mode page applies to a SPI SCSI device.

The transfer period factor field indicates the negotiated transfer period for the current I_T nexus.

The REQ/ACK offset field indicates the negotiated REQ/ACK offset for the current I_T nexus.

The transfer width exponent field indicates the negotiated transfer width exponent for the current I_T nexus.

The protocol option bits field contain the negotiated protocol options for the current I_T nexus.

The received PCOMP_EN bit contains the value of the PCOMP_EN bit received by the controller for the current I_T nexus.

The sent PCOMP_EN bit contains the value of the PCOMP_EN bit sent by the controller for the current I_T nexus.

The transceiver mode field specifies the current bus mode of the controller as defined in Table 5.55.

Table 5.55 Bus Mode

Code	Bus Mode
00b	Unknown
01b	Single ended
10b	Low Voltage Differential
11b	High Voltage Differential

MODE SELECT:(15h)

[Mode Page 19_H Sub Page 04_H]

Table 5.56 Report Transfer Capabilities Sub Page (Page Code = 19_H, Sub Page Code = 04_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code(19_H)					
	0	1	0	1	1	0	0	1
1	Sub Page Code(04_H)							
	0	0	0	0	0	1	0	0
2	Page Length(MSB)							
	0	0	0	0	0	0	0	0
3	Page Length(LSB)							
	0	0	0	0	1	0	1	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved				Protocol Identifier			
	0	0	0	0	0	0	0	1
6	Minimum Transfer Period Factor							
7	Reserved							
	0	0	0	0	0	0	0	0
8	Maximum REQ/ACK Offset							
9	Maximum Transfer Width Exponent							
10	Protocol Options Bits Supported							
11	Reserved							
	0	0	0	0	0	0	0	0
12	Reserved							
	0	0	0	0	0	0	0	0
13	Reserved							
	0	0	0	0	0	0	0	0

The negotiated settings sub page, shown in Table 5.56, is used to report the transfer capabilities for the controller. The values in this sub page are not changeable via a MODE SELECT command.

The protocol identifier of 1h indicates the protocol that this mode page applies to a SPI SCSI device.

MODE SELECT:(15h)

The Minimum Transfer Period Factor field shall be set to the smallest value of the transfer period factor supported by the controller.

The Maximum REQ/ACK Offset shall be set to the largest value of the REQ/ACK offset supported by the controller.

The Maximum Transfer Width Exponent shall be set to the largest value of the transfer width exponent supported by the controller.

The controller shall set the bits in the Protocol Options Bits Supported field indicate the protocol options supported by the controller. (see Table 5.57)

Table 5.57 Protocol Options Bits

Bit	Name
7	PCOMP_EN
6	RTI
5	RD_STRM
4	WR_FLOW
3	HOLD_MCS
2	QAS_REQ
1	DT_REQ
0	IU_REQ

MODE SELECT:(15h)

[Mode Page $1A_H$]

Table 5.58 Power Condition Control Page (Page Code = $1A_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved	SPF	Page Code($1A_H$)					
	0	0	0	1	1	0	1	0
1	Page Length							
	0	0	0	0	1	0	1	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved						Idle	Standby
	0	0	0	0	0	0		
4 | 7	(MSB) Idle Condition Timer (LSB)							
8 | 11	(MSB) Standby Condition Timer (LSB)							

An Idle bit of one indicates that the logical unit shall use the idle condition timer field to determine the length of inactivity time to wait before entering the idle condition. An Idle bit of zero indicates that the logical unit shall not enter the idle condition.
Since the controller does not support Idle bit, this bit ignore.

A Standby bit of one indicates that the logical unit shall use the standby condition timer field to determine the length of inactivity time to wait before entering the standby condition. A standby bit of zero indicates that the logical unit shall not enter the standby condition.
Since the controller does not support Standby bit, this bit ignore.

The idle condition timer field indicates the inactivity time in 100 millisecond increments that the logical unit shall wait before entering the idle condition.
Since the controller does not support idle condition timer field, this field ignore.

If the idle bit is one, a value of zero in the idle condition timer indicates the logical unit shall enter the idle condition on completion of any command.

The standby condition timer field indicates the inactivity time in 100 millisecond increments that the logical unit shall wait before entering the standby condition. This timer shall only count if the idle condition timer is equal to zero.
Since the controller does not support standby condition timer field, this field ignore.

If the standby bit is one and the IDLE bit is zero, a value of zero in the standby condition timer indicates the logical unit shall enter the standby condition on completion of any command.

If the standby bit is one and the idle bit is one, a value of zero in the standby condition timer indicates the logical unit shall enter the standby condition when the idle condition timer equals zero.

[Mode Page $1C_H$]

Table 5.59 Informational Exceptions Control Page (Page Code = $1C_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved 0	SPF 0	Page Code($1C_H$) 0	 1	 1	 1	 0	 0
1	Page Length($0A_H$) 0	 0	 0	 0	 1	 0	 1	 0
2	Perf 0	R 0	EBF	EWasc	DExcpt	Test	R 0	LogErr
3	Reserved 0	 0	 0	 0	MRIE			
4	Interval Timer (MSB)							
5	Interval Timer							
6	Interval Timer							
7	Interval Timer (LSB)							

(cont'd)

Table 5.59 Informational Exceptions Control Page (Page Code = 1CH)(cont'd)

8	Report Count (MSB)
9	Report Count
10	Report Count
11	Report Count (LSB)

The informational exceptions control page defines the methods to control the reporting of specific informational exception conditions in the controller.

The informational exception conditions occur as the result of exceeding the threshold of informational exceptions in the controller.

The informational exception conditions occur asynchronously to any commands issued by the host computer.

An EBF (Enable Background Function) bit of one indicates the target shall enable background functions. An EBF bit of zero indicates the target shall disable the functions.
Since the controller does not support EBF bit, this bit ignore.

A Perf (Performance) bit of 0 allows the informational exception operations to cause the delays of command operation from the host computer.

A Perf bit of 1 does not allow the informational exception operations to cause the delays of command operation from the host computer.
Since the controller does not support Perf bit, this bit is ignored.

A EWasc(Enable Warning) bit of zero indicates that the controller does not report the warning.
A EWasc bit of one indicates that the controller reports warning.The method for reporting the warning depends on the MRIE field setting.
Since the conroller does not support EWasc bit, this bit is ignored.

A DExcpt (Disable Exception control) bit of 0 indicates that information exception operations are enabled. The method of reporting information exception conditions is determined from the MRIE (Method of Reporting Informational Exceptions; see Table 5.60) field when the DExcpt bit is set to 0.

MODE SELECT:(15h)

A DExcpt bit of 1 indicates that the informational exception operations are disabled.

A Test bit of 1 indicates that the controller reports the results of informational exception test at each interval time (if the DExcpt bit = 0). The conditions are reported with an additional sense code and an additional sense code qualifier of 5D FF_H.
A Test bit of 0 indicates that the controller does not report the results of informational exception test.
The Test bit can't be saved regardless of a PS bit value.

The LogErr (Log errors) bit of 1 indicates the controller logs the informational exception conditions. The LogErr bit of 0 indicates the controller does not log the informational exception conditions.

The MRIE field defines the methods that the controller reports the informational exception conditions.

Table 5.60 Method of Reporting Informational Exceptions field

MRIE	Description
0 h	The controller does not report informational exceptions conditions.
2 h	Generate unit attention: The controller reports informational exceptions conditions by returning CHECK CONDITION status on the commands. The controller sets a sense key to UNIT ATTENTION and additional sense code to the cause of informational exception condition.
3 h	Conditionally generate recovered error : The controller reports informational exception conditions by returning CHECK CONDITION status on the commands in accordance with the value of the PER (Post Error) bit in mode parameter (Error recovery parameters). The controller sets a sense key to RECOVERED ERROR and additional sense code to the cause of informational exception condition.

(cont'd)

Table 5.60 Method of Reporting Informational Exceptions field (cont'd)

4 h	Unconditionally generate recovered error : The controller reports informational exceptions conditions by returning CHECK CONDITION status on the commands other than(Reassign Blocks, Request Sense, Inquiry, Start/Stop Unit, Mode Select, Report Luns) in regardless of the value of the PER (Post Error) bit in mode parameter (Error recovery parameters). The controller sets a sense key to RECOVERED ERROR and additional sense code to the cause of informational exception condition.
6 h	Only report informational exception condition on request : The controller preserves the informational exception information in it. The host computer polls the controller by issuing REQUEST SENSE command to get informational exception information. The controller sets a sense key to NO SENSE and additional sense code to the cause of informational exception condition.

This controller does not support other than the value in Table 5.60.

The Interval Timer field indicates the period in 100 millisecond increments for reporting that an informational exception condition has occurred.
The Interval Timer field of 0 indicates that the controller shall only report the informational exception condition one time.
The Interval Timer field of $FFFFFFFF_H$ indicates the timer interval is the value created by the controller (approximately 10 minutes) .

The Report Count field indicates the number of times to report an informational exception condition to the host computer.
The Report Count field of 0 indicates that there is no limit on the number of times the controller reports an informational exception condition.

Note : If Interval Timer and Report Count values set to other than the supported values are specified the controller ignores these values. The controller does not consider this condition as an error.

If the MRIE field has a value of 6, then the interval timer and report count are ignored.

MODE SELECT:(15h)

5.6 MODE SELECT (10):(55_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (55_H)							
	0	1	0	1	0	1	0	1
1	Logical Unit Number			PF	Reserved			SP
					0	0	0	
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Parameter List Length (MSB)							
8	Parameter List Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The MODE SELECT (10) command is the same as the MODE SELECT command except that the MODE SELECT (10) command has 2-byte length of Parameter List Length and 8-byte length of MODE SELECT Header as follows.

Refer to item 5.5, MODE SELECT command in detail.

MODE SELECT (10):(55h)

Table 5.61 MODE SELECT (10) Header

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							
	0	0	0	0	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	Medium Type							
	0	0	0	0	0	0	0	0
3	WP	Reserved		DPOFUA	Reserved			
		0	0		0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Block Descriptor Length (MSB)							
7	Block Descriptor Length (LSB)							

MODE SELECT (10):(55h)

5.7 MODE SENSE:($1A_H$)

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code ($1A_H$)							
	0	0	0	1	1	0	1	0
1	Logical Unit Number			R	DBD	Reserved		
				0		0	0	0
2	PC		Page Code					
3	Sub Page Code							
4	Allocation Length							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The MODE SENSE command provides a means for the controller to report its medium, logical unit, or controller parameters to the host computer.
It is a complementary command to the MODE SELECT command (See 5.5).

The DBD (Disable Block Descriptor) bit of 0 indicates the controller transfers the Block Descriptor. The DBD bit of 1 indicates the controller does not transfer the Block Descriptor.

The PC (Page Control) field defines the type (one of those listed below) of the parameter values to be returned.

Bit 7	Bit 6	
0	0	Current values
0	1	Changeable values
1	0	Default values
1	1	Saved values

The controller sets the page parameter fields and bits to values of the specified type and reports them to host computer.

[Current values]

A current value takes on one of the following values :

- The value that is set in the last successfully completed MODE SELECT command. The default value is taken for unchangeable values.
- The saved value (if no MODE SELECT command has been issued since the last power on).
- The default value if saved value is not available.

[Changeable values]

- Fields and bits that are changeable by the host computer are set to 1 and fields and bits that are not changeable by the host computer are set to 0.

[Default values]

- Values that are provided for the controller or drive prior to any Mode Parameter changes.

(Note) : Care must be taken not to confuse over whether the value of zero is the default or unsupported value.

[Saved values]

A saved value takes on one of the following values :

- The value saved during the last successfully completed FORMAT UNIT or MODE SELECT command.
- The default value (when no saving has been carried out).

Page Code identifies the page(s) to be returned. The host computer can specify the following page codes :

Page Code	Meaning
1_H	Read-write error recovery page
2_H	Disconnect-Reconnect page
3_H	Format device page
4_H	Rigid disk geometry page
7_H	Verify error recovery page
8_H	Caching page
A_H	Control mode page
C_H	Notch and partition page
18_H	Logical unit control page
19_H	Port control page
$1A_H$	Power condition control page
$1C_H$	Informational exceptions control page
$3F_H$	All pages

A page code of $3F_H$ specifies that all pages are to be transferred.

When a page code other than those listed above is specified, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

The Sub Page Code identifies the sub page code to be returned. The host computer can specify the following page code.

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Page Code	Sub Page Code	Meaning
19_H	01_H	Margin control page
19_H	02_H	Saved training configuration page
19_H	03_H	Negotiated setting page
19_H	04_H	Report Transfer Capabilities page

A sub page code of FF_H specifies that all sub pages and page 19_H are to be transferred

When a page code other than those listed above is specified, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

The Allocation Length field specifies the number of bytes that the host computer has allocated for the Mode Sense data to be returned. An allocation length of 0 specifies that no Mode Sense data is to be transferred.

This condition must not be considered as an error. Any other allocation length value specifies the maximum number of bytes that can be transferred. The controller terminates the Data In

phase when the number of bytes specified in the Allocation Length field have been transferred or when all available Mode Sense data have been transferred to the host computer, whichever is less.

The Mode Sense Data consists of a 4-byte header, followed by eight bytes of a block descriptor, followed by zero or more page descriptors.

Table 5.62 Mode Sense Data

Bit / Byte	7	6	5	4	3	2	1	0
MODE SENSE Header								
0	Sense Data Length							
1	Medium Type							
	0	0	0	0	0	0	0	0
2	WP	Reserved		DPOFUA	Reserved			
		0	0		0	0	0	0
3	Block Descriptor Length							
	0	0	0	0	1	0	0	0

(cont'd)

MODE SENSE:(1Ah)

Table 5.62 Mode Sense Data (cont'd)

Block Descriptor			
0	Number of Blocks (MSB)		
1	Number of Blocks		
2	Number of Blocks		
3	Number of Blocks (LSB)		
4	Reserved 0 0 0 0 0 0 0 0		
5	Block Length (MSB)		
6	Block Length		
7	Block Length (LSB)		
Page Descriptor (s)			
0	PS	SPF 0	Page Code
1	Page Length (in bytes)		
2 - n	Refer to Page Definition in MODE SELECT		

Table 5.63 Page Descriptor(s) (Sub_Page Mode Page Format)

Page Descriptor (s)			
0	PS	SPF 1	Page Code
1	Sub Page Code		
2 - 3	Page Length (in bytes)		
4 - n	Refer to Page Definition in MODE SELECT		

MODE SENSE:(1Ah)

The Sense Data Length field specifies the length in bytes of the following Mode Sense data that is available to be transferred during the Data In phase. It does not include the length of the Sense Data Length Field itself. The Sense Data Length field is loaded with one of the following values according to the setting of the page code in the CDB, irrespective of the value specified in the Allocation Length field in the CDB :

Table 5.64 Sense Data Length

Page Code	Sense Data Length
1_H	17_H
2_H	$1B_H$
3_H	23_H
4_H	23_H
7_H	17_H
8_H	$1F_H$
A_H	17_H
C_H	23_H
18_H	13_H
19_H	13_H
$1A_H$	17_H
$1C_H$	17_H
$3F_H$	$C3_H$

The Medium Type field is loaded with code 00_H and identifies the default medium type (the type of the currently mounted medium).

The WP (Write Protected) bit, when set to 0, indicates that the medium is enabled for write operations.
A WP bit of 1 indicates that the medium is protected against write operations.

A DPOFUA bit of 1 indicates that the DPO bit and FUA bit for READ/WRITE command are supported.

The Block Descriptor Length field specifies the length in bytes of the block descriptor. Since there is only one block descriptor, this field must always be set to 08_H.

The block descriptor contains the number of blocks and the block length and indicates the accessible area from the host for a logical unit.

The Number of Blocks field specifies the number of logical blocks on the medium that corresponds to the block length in the block descriptor.

MODE SENSE:(1Ah)

Note : The host computer can obtain the number of logical blocks by adding 1 to the maximum logical block address that is returned with the READ CAPACITY command (see 5.14).

The Block Length field specifies the length in bytes of the logical blocks on the medium.
Please refer to “Product Specifications” for the information of the eligible logical length values.

The page descriptors specify the page data requested by the host computer. For details on the pages, see the page definitions given in the MODE SELECT command description (see 5.5).

The PS (Parameter Savable) bit of 0 indicates that the controller cannot save the specified page. This bit of 1 indicates that the controller can save the specified page.

Each page descriptor lists the default and changeable values that the SCSI controller returns to the host computer. The default value XX_H indicates the case of the different values (e.g. number of heads) at each product.

[Mode Page 1_H]

Table 5.65 Mode Page 1_H Descriptor Value

Read-Write Error Recovery Page (Page 01_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			81_H	81_H	81_H
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	01_H	01_H	01_H
1		Page Length	$0A_H$	$0A_H$	$0A_H$
2			$C8_H$	FF_H	XX_H
	7	AWRE	1	1	0/1
	6	ARRE	1	1	0/1
	5	TB	0	1	0/1
	4	RC	0	1	0/1
	3	EER	1	1	0/1
	2	PER	0	1	0/1
	1	DTE	0	1	0/1
	0	DCR	0	1	0/1
3		Read Retry Count	80_H	FF_H	XX_H
4		Correction Span	$A0_H$	FF_H	XX_H
5		Head Offset Count	00_H	FF_H	XX_H
6		Data Strobe Count	00_H	FF_H	XX_H
7		Reserved	00_H	00_H	00_H
8		Write Retry Count	80_H	FF_H	XX_H
9		Reserved	00_H	00_H	00_H
10		Recovery	$0B_H$	FF_H	XX_H
11		Time Limit	$B8_H$	FF_H	XX_H

MODE SENSE:(1Ah)

[Mode Page 2_H]

Table 5.66 Mode Page 2_H Descriptor Value

Disconnect - Reconnect Page (Page 02_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			82_H	82_H	82_H
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	02_H	02_H	02_H
1		Page Length	$0E_H$	$0E_H$	$0E_H$
2		Buffer Full Ratio	00_H	FF_H	XX_H
3		Buffer Empty Ratio	80_H	FF_H	XX_H
4		Bus Inactivity Limit	00_H	FF_H	XX_H
5			00_H	FF_H	XX_H
6		Disconnect Time Limit	00_H	FF_H	XX_H
7			00_H	FF_H	XX_H
8		Connect Time Limit	00_H	FF_H	XX_H
9			00_H	FF_H	XX_H
10		Maximum Burst Size	00_H	FF_H	XX_H
11			00_H	FF_H	XX_H
12			10_H	$7F_H$	XX_H
	7	Reserved	0_H	0_H	0_H
	6-4	Fair Arbitration	1_H	7_H	$0/1_H$
	3	DIMM	0_H	1_H	$0/1_H$
	2-0	DTDC	0_H	7_H	$0_H/1_H/3_H$
13		Reserved	00_H	00_H	00_H
14		Reserved	00_H	00_H	00_H
15		Reserved	00_H	00_H	00_H

MODE SENSE:(1Ah)

[Mode Page 3_H]

Table 5.67 Mode Page 3_H Descriptor Value

Format Device Page (Page 03_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			83_H	83_H	83_H
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	03_H	03_H	03_H
1		Page Length	16_H	16_H	16_H
2		Tracks per Zone	XX_H	00_H	XX_H
3			XX_H	00_H	XX_H
4		Alternate Sectors per Zone	XX_H	00_H	XX_H
5			XX_H	00_H	XX_H
6		Alternate Tracks per Zone	00_H	00_H	00_H
7			XX_H	00_H	XX_H
8		Alternate Tracks per Volume	XX_H	00_H	XX_H
9			XX_H	00_H	XX_H
10		Sectors per Track	XX_H	00_H	XX_H
11			XX_H	00_H	XX_H
12		Data Bytes per Physical Sector	02_H	FF_H	XX_H
13			00_H	FF_H	XX_H
14		Interleave	00_H	00_H	00_H
15			01_H	00_H	01_H
16		Track Skew Factor	00_H	00_H	00_H
17			XX_H	00_H	XX_H
18		Cylinder Skew Factor	00_H	00_H	00_H
19			XX_H	00_H	XX_H
20			40_H	00_H	40_H
	7	SSEC	0	0	0
	6	HSEC	1	0	1
	5	RMB	0	0	0
	4	SURF	0	0	0
	3	INS	0	0	0
	2-0	Reserved	0_H	0_H	0_H
21		Reserved	00_H	00_H	00_H
22		Reserved	00_H	00_H	00_H
23		Reserved	00_H	00_H	00_H

MODE SENSE:(1Ah)

[Mode Page 4_H]

Table 5.68 Mode Page 4_H Descriptor Value

Rigid Disk Geometry Page (Page 04_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			84_H	84_H	84_H
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	04_H	04_H	04_H
1		Page Length	16_H	16_H	16_H
2		Number of Cylinders	00_H	00_H	00_H
3			XX_H	00_H	XX_H
4			XX_H	00_H	XX_H
5		Number of Heads	XX_H	00_H	XX_H
6		Starting Cylinder-Write Precompensation	00_H	00_H	00_H
7			00_H	00_H	00_H
8			00_H	00_H	00_H
9		Starting Cylinder-Reduced Write Current	00_H	00_H	00_H
10			00_H	00_H	00_H
11			00_H	00_H	00_H
12		Drive Step Rate	00_H	00_H	00_H
13			00_H	00_H	00_H
14		Landing Zone Cylinder	00_H	00_H	00_H
15			00_H	00_H	00_H
16			00_H	00_H	00_H
17			00_H	00_H	00_H
	7-2	Reserved	0_H	0_H	0_H
	1,0	RPL	0_H	0_H	0_H
18		Rotational Offset	00_H	00_H	00_H
19		Reserved	00_H	00_H	00_H
20		Medium Rotation Rate	$3A_H$	00_H	$3A_H$
21			BD_H	00_H	BD_H
22		Reserved	00_H	00_H	00_H
23		Reserved	00_H	00_H	00_H

MODE SENSE:(1Ah)

[Mode Page 7_H]

Table 5.69 Mode Page 7_H Descriptor Value

Verify Error Recovery Page (Page 07_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			87_H	87_H	87_H
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	07_H	07_H	07_H
1		Page Length	$0A_H$	$0A_H$	$0A_H$
2			08_H	$0F_H$	XX_H
	7-4	Reserved	0_H	0_H	0_H
	3	EER	1	1	0/1
	2	PER	0	1	0/1
	1	DTE	0	1	0/1
	0	DCR	0	1	0/1
3		Verify Retry Count	80_H	FF_H	XX_H
4		Verify Correction Span	$A0_H$	FF_H	XX_H
5		Reserved	00_H	00_H	00_H
6		Reserved	00_H	00_H	00_H
7		Reserved	00_H	00_H	00_H
8		Reserved	00_H	00_H	00_H
9		Reserved	00_H	00_H	00_H
10		Verify Recovery Time Limit	$0B_H$	FF_H	XX_H
11			$B8_H$	FF_H	XX_H

MODE SENSE:(1Ah)

[Mode Page 8_H]

Table 5.70 Mode Page 8_H Descriptor Value

Caching Page (Page 08_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			88_H	88_H	88_H
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	08_H	08_H	08_H
1		Page Length	12_H	12_H	12_H
2			04_H	BF_H	XX_H
	7	IC	0	1	0/1
	6	Reserved	0	0	0
	5	CAP	0	1	0/1
	4	DISC	0	1	0/1
	3	SIZE	0	1	0/1
	2	WCE	1	1	0/1
	1	MF	0	1	0/1
	0	RCD	0	1	0/1
3			00_H	00_H	00_H
	7-4	Demand Read Retention Priority	0_H	0_H	0_H
	3-0	Write Retention Priority	0_H	0_H	0_H
4		Disable Pre-fetch Transfer Length	FF_H	FF_H	FF_H
5			FF_H	FF_H	FF_H
6		Minimum Pre-fetch	00_H	FF_H	00_H
7			00_H	FF_H	00_H
8		Maximum Pre-fetch	FF_H	FF_H	XX_H
9			FF_H	FF_H	XX_H
10		Maximum Pre-fetch Ceiling	FF_H	FF_H	XX_H
11			FF_H	FF_H	XX_H
12			40_H	$E0_H$	XX_H
	7	FSW	0	1	0/1
	6	LBCSS	1	1	0/1
	5	DRA	0	1	0/1
	4-0	Reserved	00_H	00_H	00_H
13		Number of Cache Segment	XX_H	FF_H	XX_H
14		Cache Segment Size	XX_H	FF_H	XX_H
15			XX_H	FF_H	XX_H
16-19		Reserved	00_H -00_H	00_H -00_H	00_H -00_H

MODE SENSE:(1Ah)

[Mode Page A_H]

Table 5.71 Mode Page A_H Descriptor Value

Control Mode Page (Page $0A_H$)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			$8A_H$	$8A_H$	$8A_H$
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	$0A_H$	$0A_H$	$0A_H$
1		Page Length	$0A_H$	$0A_H$	$0A_H$
2			02_H	02_H	XX_H
	7-2	Reserved	0_H	0_H	0_H
	1	GLTSD	1	1	0/1
	0	RLEC	0	0	0
3			00_H	$F3_H$	XX_H
	7-4	Queue Algorithm Modifier	0_H	F_H	X_H
	3-2	Reserved	0_H	0_H	0_H
	1	QErr	0	1	0/1
	0	DQue	0	1	0/1
4			00_H	00_H	00_H
	7	EECA	0	0	0
	6-3	Reserved	0_H	0_H	0_H
	2	RAENP	0	0	0
	1	UAAENP	0	0	0
	0	EAENP	0	0	0
5		Reserved	00_H	00_H	00_H
6		Ready AEN Holdoff Period	00_H	00_H	00_H
7			00_H	00_H	00_H
8		Busy Timeout Period	00_H	FF_H	XX_H
9			00_H	FF_H	XX_H
10		Extended Self-Test Completion Time	XX_H	00_H	XX_H
11			XX_H	00_H	XX_H

MODE SENSE:(1Ah)

[Mode Page C_H]

Table 5.72 Mode Page C_H Descriptor Value

Notch and Partition Page (Page $0C_H$)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			$0C_H$	$0C_H$	$0C_H$
	7	PS	0	0	0
	6	SPF	0	0	0
	5-0	Page Code	$0C_H$	$0C_H$	$0C_H$
1		Page Length	16_H	16_H	16_H
2			80_H	40_H	XX_H
	7	ND	1	0	1
	6	LPN	0	1	0/1
	5-0	Reserved	0_H	0_H	0_H
3		Reserved	00_H	00_H	00_H
4		Maximum Number of Notches	00_H	00_H	00_H
5			12_H	00_H	12_H
6		Active Notch	00_H	FF_H	XX_H
7			00_H	FF_H	XX_H
8		Starting Boundary	00_H	00_H	00_H
9			00_H	00_H	00_H
10			00_H	00_H	00_H
11			00_H	00_H	00_H
12		Ending Boundary	00_H	00_H	XX_H
13			XX_H	00_H	XX_H
14			XX_H	00_H	XX_H
15			XX_H	00_H	XX_H
16		Page Notched	00_H	00_H	00_H
17			00_H	00_H	00_H
18			00_H	00_H	00_H
19			00_H	00_H	00_H
20			00_H	00_H	00_H
21			00_H	00_H	00_H
22			10_H	00_H	10_H
23			08_H	00_H	08_H

MODE SENSE:(1Ah)

[Mode Page 18_H]

Table 5.73 Mode Page 18_H Descriptor Value

Logical Unit Control Page (Page 18_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			98_H	98_H	98_H
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	18_H	18_H	18_H
1		Page Length	06_H	06_H	06_H
2			01_H	00_H	01_H
	7-4	Reserved	0_H	0_H	0_H
	3-0	Protocol Identifier	1_H	0_H	1_H
3		Reserved	00_H	00_H	00_H
4		Reserved	00_H	00_H	00_H
5		Reserved	00_H	00_H	00_H
6		Reserved	00_H	00_H	00_H
7		Reserved	00_H	00_H	00_H

[Mode Page 19_H]

Table 5.74 Mode Page 19_H Descriptor Value

Port Control Page (Page 19_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			99_H	99_H	99_H
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	19_H	19_H	19_H
1		Page Length	06_H	06_H	06_H
2			01_H	00_H	01_H
	7-4	Reserved	0_H	0_H	0_H
	3-0	Protocol Identifier	1_H	0_H	1_H
3		Reserved	00_H	00_H	00_H
4		Synchronous Transfer Timeout	00_H	FF_H	XX_H
5			00_H	FF_H	XX_H
6		Reserved	00_H	00_H	00_H
7		Reserved	00_H	00_H	00_H

MODE SENSE:(1Ah)

[Mode Page 19_H , Sub Page 01_H]

Table 5.75 Mode Page 19_H , Sub Page 01_H Descriptor Value

Margin Control Page (Page 19_H, Sub Page 01_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			$D9_H$	$D9_H$	$D9_H$
	7	PS	1	1	1
	6	SPF	1	1	1
	5-0	Page Code	19_H	19_H	19_H
1		Sub Page Code	01_H	01_H	01_H
2		Page Length	00_H	00_H	00_H
3			12_H	12_H	12_H
4		Reserved	00_H	00_H	00_H
5			01_H	00_H	01_H
	7-4	Reserved	0_H	0_H	0_H
	3-0	Protocol Identifier	1_H	0_H	1_H
6		Reserved	00_H	00_H	00_H
7			00_H	$F0_H$	$X0_H$
	7-4	Driver Strength	0_H	F_H	X_H
	3-0	Reserved	0_H	0_H	0_H
8			01_H	FF_H	XX_H
	7-4	Driver Asymmetry	0_H	F_H	X_H
	3-0	Driver Precompensation	1_H	F_H	X_H
9			30_H	$F0_H$	$X0_H$
	7-4	Slew Rate	3_H	F_H	X_H
	3-0	Reserve	0_H	0_H	0_H
10		Reserved	00_H	00_H	00_H
11		Reserved	00_H	00_H	00_H
12		Reserved	00_H	00_H	00_H
13		Vendor Specific	00_H	00_H	00_H
14		Reserved	00_H	00_H	00_H
15		Reserved	00_H	00_H	00_H
16		Reserved	00_H	00_H	00_H
17		Reserved	00_H	00_H	00_H
18		Reserved	00_H	00_H	00_H
19		Reserved	00_H	00_H	00_H
20		Reserved	00_H	00_H	00_H
21		Reserved	00_H	00_H	00_H

MODE SENSE:(1Ah)

[Mode Page 19_H , Sub Page 02_H]

Table 5.76 Mode Page 19_H , Sub Page 02_H Descriptor Value

Saved Training Configuration Page (Page 19_H, Sub Page 02_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			59_H	59_H	59_H
	7	PS	0	0	0
	6	SPF	1	1	1
	5-0	Page Code	19_H	19_H	19_H
1		Sub Page Code	02_H	02_H	02_H
2		Page Length	00_H	00_H	00_H
3			$E6_H$	$E6_H$	$E6_H$
4		Reserved	00_H	00_H	00_H
5			01_H	00_H	01_H
	7-4	Reserved	0_H	0_H	0_H
	3-0	Protocol Identifier	1_H	0_H	1_H
6-9		Reserved	00_H -00_H	00_H -00_H	00_H -00_H
10-13		DB (0) Value	00000000_H	00000000_H	$XXXXXXXX_H$
14-17		DB (1) Value	00000000_H	00000000_H	$XXXXXXXX_H$
18-21		DB (2) Value	00000000_H	00000000_H	$XXXXXXXX_H$
22-25		DB (3) Value	00000000_H	00000000_H	$XXXXXXXX_H$
26-29		DB (4) Value	00000000_H	00000000_H	$XXXXXXXX_H$
30-33		DB (5) Value	00000000_H	00000000_H	$XXXXXXXX_H$
34-37		DB (6) Value	00000000_H	00000000_H	$XXXXXXXX_H$
38-41		DB (7) Value	00000000_H	00000000_H	$XXXXXXXX_H$
42-45		DB (8) Value	00000000_H	00000000_H	$XXXXXXXX_H$
46-49		DB (9) Value	00000000_H	00000000_H	$XXXXXXXX_H$
50-53		DB (10) Value	00000000_H	00000000_H	$XXXXXXXX_H$
54-57		DB (11) Value	00000000_H	00000000_H	$XXXXXXXX_H$
58-61		DB (12) Value	00000000_H	00000000_H	$XXXXXXXX_H$
62-65		DB (13) Value	00000000_H	00000000_H	$XXXXXXXX_H$
66-69		DB (14) Value	00000000_H	00000000_H	$XXXXXXXX_H$
70-73		DB (15) Value	00000000_H	00000000_H	$XXXXXXXX_H$
74-77		P_CRCA Value	00000000_H	00000000_H	$XXXXXXXX_H$
78-81		P1 Value	00000000_H	00000000_H	$XXXXXXXX_H$
82-85		BSY Value	00000000_H	00000000_H	00000000_H
86-89		SEL Value	00000000_H	00000000_H	00000000_H
90-93		RST Value	00000000_H	00000000_H	00000000_H

(cont'd)

MODE SENSE:(1Ah)

Table 5.76 Mode Page 19H , Sub Page 02H Descriptor Value (cont'd)

94-97		REQ Value	00000000_H	00000000_H	$XXXXXXXX_H$
98-101		ACK Value	00000000_H	00000000_H	$XXXXXXXX_H$
102-105		ATN Value	00000000_H	00000000_H	00000000_H
106-109		C/D Value	00000000_H	00000000_H	00000000_H
110-113		I/O Value	00000000_H	00000000_H	00000000_H
114-117		MSG Value	00000000_H	00000000_H	00000000_H
118-233		Reserved	00000000_H	00000000_H	00000000_H

[Mode Page 19_H , Sub Page 03_H]

Table 5.77 Mode Page 19_H , Sub Page 03_H Descriptor Value

Negotiated Setting Page (Page 19_H, Sub Page 03_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			59_H	59_H	59_H
	7	PS	0	0	0
	6	SPF	1	1	1
	5-0	Page Code	19_H	19_H	19_H
1		Sub Page Code	03_H	03_H	03_H
2		Page Length	00_H	00_H	00_H
3			$0A_H$	$0A_H$	$0A_H$
4		Reserved	00_H	00_H	00_H
5			01_H	00_H	01_H
	7-4	Reserved	0_H	0_H	0_H
	3-0	Protocol Identifier	1_H	0_H	1_H
6		Transfer Period Factor	00_H	00_H	XX_H
7		Reserved	00_H	00_H	00_H
8		REQ/ACK Offset	00_H	00_H	XX_H
9		Transfer Width Exponent	00_H	00_H	XX_H
10			00_H	00_H	XX_H
	7	Reserved	0	0	0
	6-0	Protocol Option bits	00_H	00_H	XX_H

(cont'd)

MODE SENSE:(1Ah)

Table 5.77 Mode Page 19H , Sub Page 03H Descriptor Value (cont'd)

11			00_H	00_H	$0X_H$
	7-4	Reserved	0_H	0_H	0_H
	3-2	Transceiver Mode	0_H	0_H	X_H
	1	Sent PCOMP_EN	0	0	0/1
	0	Received PCOMP_EN	0	0	0/1
12		Reserved	00_H	00_H	00_H
13		Reserved	00_H	00_H	00_H

[Mode Page 19_H , Sub Page 04_H]

Mode Page 19_H , Sub Page 04_H Descriptor Value

Report Transfer Capabilities Page (Page 19_H, Sub Page 04_H)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			59_H	59_H	59_H
	7	PS	0	0	0
	6	SPF	1	1	1
	5-0	Page Code	19_H	19_H	19_H
1		Sub Page Code	04_H	04_H	04_H
2		Page Length	00_H	00_H	00_H
3			$0A_H$	$0A_H$	$0A_H$
4		Reserved	00_H	00_H	00_H
5			01_H	01_H	01_H
	7-4	Reserved	0_H	0_H	0_H
	3-0	Protocol Identifier	1_H	1_H	1_H
6		Minimum Transfer Period Factor	00_H	00_H	XX_H
7		Reserved	0_H	0_H	0_H
8		Maximum REQ/ACK Offset	00_H	00_H	XX_H
9		Maximum Transfer Width Exponent	00_H	00_H	01_H
10		Protocol Option Bits Supported	00_H	00_H	XX_H
11		Reserved	00_H	00_H	00_H
12		Reserved	00_H	00_H	00_H
13		Reserved	00_H	00_H	00_H

MODE SENSE:(1Ah)

		Single Ended		Low Voltage Differential	
		Current	Saved	Current	Saved
1	Minimum Transfer Period Factor	$0C_H$	00_H	08_H	00_H
2	Maximum REQ/ACK Offset	51_H	00_H	51_H	00_H
3	Maximum Transfer Width Exponent	01_H	00_H	01_H	00_H
4	Protocol Options Bits Supported	00_H	00_H	FF_H	00_H

[Mode Page $1A_H$]

Table 5.78 Mode Page $1A_H$ Descriptor Value

Power Condition Control Page (Page $1A_H$)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			$1A_H$	$1A_H$	$1A_H$
	7	PS	0	0	0
	6	SPF	0	0	0
	5-0	Page Code	$1A_H$	$1A_H$	$1A_H$
1		Page Length	$0A_H$	$0A_H$	$0A_H$
2		Reserved	00_H	00_H	00_H
3			02_H	00_H	02_H
	7-2	Reserved	0_H	0_H	0_H
	1	Idle	1	0	1
	0	Standby	0	0	0
4		Idle Condition Timer	00_H	00_H	00_H
5			00_H	00_H	00_H
6			00_H	00_H	00_H
7			01_H	00_H	01_H
8		Standby Condition Timer	00_H	00_H	00_H
9			00_H	00_H	00_H
10			00_H	00_H	00_H
11			00_H	00_H	00_H

MODE SENSE:(1Ah)

[Mode Page $1C_H$]

Table 5.79 Mode Page $1C_H$ Descriptor Value

Informational Exceptions Control Page (Page $1C_H$)					
Byte	Bit	Meaning	Default Values	Changeable Values	Current/Saved Values
0			$9C_H$	$9C_H$	$9C_H$
	7	PS	1	1	1
	6	SPF	0	0	0
	5-0	Page Code	$1C_H$	$1C_H$	$1C_H$
1		Page Length	$0A_H$	$0A_H$	$0A_H$
2			29_H	BD_H	XX_H
	7	Perf	0	1	0/1
	6	Reserved	0	0	0
	5	EBF	1	1	0/1
	4	EWasc	0	1	0/1
	3	DExcpt	1	1	0/1
	2	Test	0	1	0/1
	1	Reserved	0	0	0
	0	LogErr	1	1	0/1
3			04_H	$0F_H$	$0X_H$
	7-4	Reserved	0_H	0_H	0_H
	3-0	MRIE	4_H	F_H	X_H
4		Interval Timer	00_H	FF_H	XX_H
5			00_H	FF_H	XX_H
6			00_H	FF_H	XX_H
7			00_H	FF_H	XX_H
8		Report Count	00_H	FF_H	XX_H
9			00_H	FF_H	XX_H
10			00_H	FF_H	XX_H
11			01_H	FF_H	XX_H

MODE SENSE:(1Ah)

5.8 MODE SENSE (10):($5A_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($5A_H$)							
	0	1	0	1	1	0	1	0
1	Logical Unit Number			R	DBD	Reserved		
				0		0	0	0
2	PC		Page Code					
3	Sub Page Code							
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The MODE SENSE (10) command is the same as the MODE SENSE command except that the MODE SENSE (10) command has 2-byte length of Allocation Length and 8-byte length of MODE SENSE Header as follows.

Refer to item 5.7 MODE SENSE command in detail.

MODE SENSE (10):(5Ah)

Table 5.80 MODE SENSE (10) Header

Byte \ Bit	7	6	5	4	3	2	1	0
0	Sense Data Length (MSB)							
1	Sense Data Length (LSB)							
2	Medium Type							
	0	0	0	0	0	0	0	0
3	WP	Reserved		DPOFUA	Reserved			
		0	0		0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Block Descriptor Length (MSB)							
	0	0	0	0	0	0	0	0
7	Block Descriptor Length (LSB)							
	0	0	0	0	1	0	0	0

MODE SENSE (10):(5Ah)

5.9 PERSISTENT RESERVE IN:(5Eh)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code($5E_H$)							
	0	1	0	1	1	1	1	0
1	Logical Unit Number			Service Action				
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The PERSISTENT RESERVE IN command is used to obtain information about persistent reservations and reservation keys that are active within the controller. This command is used in conjunction with the PERSISTENT RESERVE OUT command (see 5.10).

The PERSISTENT RESERVE IN parameter data includes a field that indicates the number of parameter data bytes available to be returned. The Allocation Length field in the CDB indicates how much space has been allocated for the returned parameter list. An allocation length that is not sufficient to contain the entire parameter list shall not be considered an error. If the complete list is required, the application client should send a new PERSISTENT RESERVE IN command with allocation length large enough to contain the entire list.

The service action codes for the PERSISTENT RESERVE IN command are defined in Table 5.81.

Table 5.81 PERSISTENT RESERVE IN Service Action Code

Code	Name	Description
00_H	READ KEYS	Reads all registered Reservation Keys
01_H	READ RESERVATION	Reads the current persistent reservations
02_H-$1F_H$	Reserved	Reserved

When Service Action Code reserved by Service Action is specified, a controller sets INVALID FIELD IN CDB to a sense key at ILLEGAL REQUEST and a additional sense key, and makes it CHECK CONDITION status.

The format for the parameter data provided in response to a PERSISTENT RESERVE IN command with the READ KEYS service action is shown in Table 5.82..

Table 5.82 READ KEYS Parameter Data

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•	GENERATION							
•								
3								(LSB)
4	(MSB)							
•	Additional Length(N-7)							
•								
7								(LSB)
Reservation Key List								
8	(MSB)							
•	First reservation key							
•								
15								(LSB)
•	•							
•	•							
N-7	(MSB)							
•	Last reservation key							
•								
N								(LSB)

PERSISTENT RESERVE IN:(5Eh)

The GENERATION field shall contain a 32-bit counter maintained by the device server that shall be incremented every time a PERSISTENT RESERVE OUT command requests a REGISTER, a REGISTER AND IGNORE EXISTING KEY, a CLEAR, a PREEMPT, or a PREEMPT AND ABORT service action. The counter shall not be incremented by a PERSISTENT RESERVE IN command, by a PERSISTENT RESERVE OUT command that performs a RESERVE or RELEASE service action, or by a PERSISTENT RESERVE OUT command that is terminated due to an error or reservation conflict. Regardless of the APTPL bit value the generation value shall be set to zero as part of the power on reset process.

The additional length field contains a count of the number of bytes in the Reservation key list. If the allocation length specified by the PERSISTENT RESERVE IN command is not sufficient to contain the entire parameter list, then only the first portion of the list (byte 0 to the allocation length) shall be sent to the application client. The incremental remaining bytes shall be truncated, although the additional length field shall still contain the actual number of bytes in the reservation key list without consideration of any truncation resulting from an insufficient allocation length. This shall not be considered an error.

The reservation key list contains the 8-byte reservation keys for all initiators that have registered through all ports with the device server.

The format for the parameter data provided in response to a PERSISTENT RESERVE IN command with the READ RESERVATION service action is shown in Table 5.83.

Table 5.83 READ RESERVATION Parameter Data

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)							
•				GENERATION				
•								
3								(LSB)
4	(MSB)							
•				Additional Length(N-7)				
•								
7								(LSB)

(cont'd)

Table 5.83 READ RESERVATION Parameter Data (cont'd)

Reservation Descriptors	
8	(MSB)
•	Reservation Descriptor
•	
N	(LSB)

The GENERATION field shall contain a 32-bit counter maintained by the device server that shall be incremented every time a PERSISTENT RESERVE OUT command requests a REGISTER, a REGISTER AND IGNORE EXISTING KEY, a CLEAR, a PREEMPT, or a PREEMPT AND ABORT service action. The counter shall not be incremented by a PERSISTENT RESERVE IN command, by a PERSISTENT RESERVE OUT command that performs a RESERVE or RELEASE service action, or by a PERSISTENT RESERVE OUT command that is terminated due to an error or reservation conflict. Regardless of the APTPL bit value the generation value shall be set to zero as part of the power on reset process.

The additional length field contains a count of the number of bytes to follow in reservation descriptor(s). If the allocation length specified by the PERSISTENT RESERVE IN command is not sufficient to contain the entire parameter list, then only the first portion of the list (byte 0 to the allocation length) shall be sent to the application client. The incremental remaining bytes shall be truncated, although the additional length field shall still contain the actual number of bytes of reservation descriptor(s) and shall not be affected by the truncation. This shall not be considered an error.

The format of the reservation descriptors is defined in Table 5.84. There shall be a reservation descriptor for the persistent reservation, if any, present in the logical unit and a reservation descriptor for each element, if any, having a persistent reservation.

Table 5.84 PERSISTENT RESERVE IN reservation descriptor

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)							
•	Reservation Key							
•								
7								(LSB)

(cont'd)

Table 5.84 PERSISTENT RESERVE IN reservation descriptor (cont'd)

8	(MSB)	
•	Scope-Specific Address	
•		
11		(LSB)
12	Reserved	
13	Scope	Type
14	Reserved	
15	Reserved	

If a persistent reservation is present in the logical unit that does not contain elements, there shall be a single reservation descriptor in the list of parameter data returned by the device server in response to the PERSISTENT RESERVE IN command with a READ RESERVATION service action. The reservation descriptor for each reservation shall contain the reservation key under which the persistent reservation is held.

The type and scope of each persistent reservation as present in the PERSISTENT RESERVE OUT command that created the persistent reservation shall be returned.

If a persistent reservation is present in the logical unit that does contain elements, there shall be a reservation descriptor in the list of parameter data returned by the device server in response to the PERSISTENT RESERVE IN command with a READ RESERVATION service action for the LU_SCOPE persistent reservation that is held, if any, and each ELEMENT_SCOPE persistent reservation that may be held. The reservation descriptor shall contain the RESERVATION KEY under which the persistent reservation is held. The TYPE and SCOPE of the persistent reservation as present in the PERSISTENT RESERVE OUT command that created the persistent reservation shall be returned.

If the scope is an ELEMENT_SCOPE reservation, the scope-specific address field shall contain the element address, zero filled in the most significant bits to fit the field. If the scope is a LU_SCOPE reservation, the scope-specific address field shall be set to zero.

Since the controller does not support ELEMENT_SCOPE reservation.

The value in the scope field shall indicate whether a persistent reservation applies to an entire logical unit or to an element. The values in the scope field are defined in Table 5.85.

Table 5.85 Persistent reservation scope codes

Code	Name	Description
0_H	LU_SCOPE	Persistent reservation applies to the full logical unit
1_H	Reserved	Reserved
2_H	ELEMENT_SCOPE	Persistent reservation applies to the specified element (does not support)
3_H - F_H	Reserved	Reserved

A scope field value of LU_SCOPE shall indicate that the persistent reservation applies to the entire logical unit.

The LU_SCOPE scope shall be implemented by all device servers that implement PERSISTENT RESERVE OUT.

A scope field value of ELEMENT_SCOPE shall indicate that the persistent reservation applies to the element of the logical unit defined by the scope-specific address field in the PERSISTENT RESERVE OUT parameter list.

Since the controller does not support ELEMENT_SCOPE reservation

The value in the TYPE field shall specify the characteristics of the persistent reservation being established for all data blocks within the element or within the logical unit. Table 5.86 defines the characteristics of the different type values. For each persistent reservation type, Table 5.86 lists code value and describes the required device server support. In Table 5.86, the description of required device server support is divided into two paragraphs. The first paragraph defines the required handling for read operations. The second paragraph defines the required handling for write operations.

Table 5.86 Persistent Reservation Type Code

Code	Name	Description
0_H	Reserved	Reserved
1_H	WRITE EXCLUSIVE	**Reads Shared**: Any application client on any initiator may initiate tasks that request transfers from the storage medium or cache of the logical unit to the initiator. **Writes Exclusive**: Any task from any initiator other than the initiator holding the persistent reservation that requests a transfer from the initiator to the storage medium or cache of the logical unit shall be terminated with RESERVATION CONFLICT status.
2_H	Reserved	Reserved
3_H	EXCLUSIVE ACCESS	**Reads Exclusive**: Any task from any initiator other than the initiator holding the persistent reservation that requests a transfer from the storage medium or cache of the logical unit to the initiator shall be terminated with RESERVATION CONFLICT status. **Writes Exclusive**: Any task from any initiator other than the initiator holding the persistent reservation that requests a transfer from the initiator to the storage medium or cache of the logical unit shall be terminated with RESERVATION CONFLICT status.
4_H	Reserved	Reserved
5_H	WRITE EXCLUSIVE-REGISTRANTS ONLY	**Reads Shared**: Any application client on any initiator may initiate tasks that request transfers from the storage medium or cache of the logical unit to the initiator. **Writes Exclusive:** A task that requests a transfer to the storage medium or cache of the logical unit from an initiator that is not currently registered with the device server shall be terminated with RESERVATION CONFLICT status.
6_H	EXCLUSIVE ACCESS-REGISTRANTS ONLY	**Reads Exclusive**: A task that requests a transfer from the storage medium or cache of the logical unit to an initiator that is not currently registered with the device server shall be terminated with RESERVATION CONFLICT status. **Writes Exclusive:** A task that requests a transfer to the storage medium or cache of the logical unit from an initiator that is not currently registered with the device server shall be terminated with RESERVATION CONFLICT status.
7_H - F_H	Reserved	Reserved

PERSISTENT RESERVE IN:(5Eh)

5.10 PERSISTENT RESERVE OUT:(5Fh)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code($5F_H$)							
	0	1	0	1	1	1	1	1
1	Logical Unit Number			Service Action				
2	Scope				Type			
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Parameter List Length(MSB)							
8	Parameter List Length(LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The PERSISTENT RESERVE OUT command is used to request service actions that reserve a logical unit or element for the exclusive or shared use of the host computer initiator. The command uses other service actions to manage and remove such reser vations. The command shall be used in conjunction with the PERSISTENT RESERVE IN command (see 5.9) and shall not be used with the RESERVE command (see 5.24) and RELEASE command (see 5.20).

The host computers performing PERSISTENT RESERVE OUT service actions are identified by a reservation key provided by the application client. An application client may use the PERSISTENT RESERVE IN command to obtain the reservation key for the initiator holding a persistent reservation and may use the PERSISTENT RESERVE OUT command to preempt that reservation.

If a PERSISTENT RESERVE OUT command is attempted, but there are insufficient device server resources to complete the operation, the device server shall return a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense data shall be set to INSUFFICIENT REGISTRATION RESOURCES.

PERSISTENT RESERVE OUT:(5Fh)

This controller can register one Reservation Key per host. That is, Reservation Key of a maximum of 16 can be registered by the whole the controller.

The PERSISTENT RESERVE OUT command contains fields that specify a persistent reservation service action, the intended scope of the persistent reservation, and the restrictions caused by the persistent reservation. The type and scope fields are defined in Table 5.86 and Table 5.85. If a scope field specifies a scope that is not implemented, the device server shall return a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and additional sense data shall be set to INVALID FIELD IN CDB.

Fields contained in the PERSISTENT RESERVE OUT parameter list specify the information required to perform a particular persistent reservation service action.

The parameter list shall be 24 bytes in length and the PARAMETER LIST LENGTH field shall contain 24 (18h). If the parameter list length is not 24, the controller shall return a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense data shall be set to PARAMETER LIST LENGTH ERROR.

When processing the PERSISTENT RESERVE OUT service actions, the device server shall increment the generation value as specified in section 5.9.

The PERSISTENT RESERVE OUT command service actions are defined in Table 5.87.

Table 5.87 PERSISTENT RESERVE OUT Service Action Code

Code	Name	Description	GENERATION field incremented
00_H	REGISTER	Register a reservation key with the device server.	Yes
01_H	RESERVE	Creates a persistent reservation having a specified scope and type. The scope and type of a persistent reservation.	No
02_H	RELEASE	Releases the selected reservation for the requesting initiator.	No
03_H	CLEAR	Clears all reservation keys and all persistent reservations.	Yes
04_H	PREEMPT	Preempts persistent reservations from another host computer.	Yes

(cont'd)

PERSISTENT RESERVE OUT:(5Fh)

Table 5.87 PERSISTENT RESERVE OUT Service Action Code (cont'd)

05_H	PREEMPT AND ABORT	Preempts persistent reservations from another initiator and aborts all tasks for all initiators registered with the specified reservation key.	Yes
06_H	REGISTER AND IGNORE EXISTING KEY	Register a reservation key with the controller.	Yes
07_H – $1F_H$	Reserved	Reserved	-

The parameter list required to perform the PERSISTENT RESERVE OUT command is defined in Table 5.88. All fields shall be sent on all PERSISTENT RESERVE OUT commands, even if the field is not required for the specified service action and scope values.

Table 5.88 PERSISTENT RESERVATION OUT Parameter List

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)							
•	Reservation Key							
•								
7								(LSB)
8	(MSB)							
•	Service Action Reservation Key							
•								
15								(LSB)
16	(MSB)							
•	Scope-Specific Address							
•								
19								(LSB)
20	Reserved							APTPL
21	Reserved							
22	Reserved							
23	Reserved							

The reservation key field contains an 8-byte value provided by the host computer to the controller to identify the initiator that is the source of the PERSISTENT RESERVE OUT command. The device server shall verify that the contents of the reservation key field in a PERSISTENT RESERVE OUT command parameter data matches the registered reservation key for the initiator from which the task was received, except for:

a) the REGISTER AND IGNORE EXISTING KEY service action where the RESERVATION KEY field shall be ignored; and
b) the REGISTER service action for an unregistered initiator where the RESERVATION KEY field shall contain zero.

Except as noted above, when a PERSISTENT RESERVE OUT command specifies a reservation key field other than the reservation key registered for the initiator the device server shall return a RESERVATION CONFLICT status. Except as noted above, the reservation key of the initiator shall be verified to be correct regardless of the service action and scope field values.

The service action reservation key field contains information needed for four service actions; the REGISTER, REGISTER AND IGNORE EXISTING KEY, PREEMPT, and PREEMPT AND ABORT service actions. For the REGISTER and REGISTER AND IGNORE EXISTING KEY service action, the service action reservation key field contains the new reservation key to be registered. For the PREEMPT and PREEMPT AND ABORT service actions, the service action reservation key field contains the reservation key of the persistent reservations that are being preempted. The service action reservation key field is ignored for all other service actions.

If the scope is an ELEMENT_SCOPE reservation, the scope-specific address field shall contain the element address, zero filled in the most significant bits to fit the field. If the service action is REGISTER, REGISTER AND IGNORE EXISTING KEY, or CLEAR or if the scope is a LU_SCOPE reservation, the scope-specific address field shall be set to zero.
Since the controller supports only LU_SCOPE, when value other than zero is specified to be scope-specific addresses, it ignored value.

The APTPL (Activate Persist Through Power Loss) bit shall be valid only for the REGISTER, or the REGISTER AND IGNORE EXISTING KEY service action. In all other cases, the APTPL bit shall be ignored. Support for an APTPL bit equal to one is optional. If a device server that does not support the APTPL bit value of one receives that value in a REGISTER or a REGISTER AND IGNORE EXISTING KEY service action, the device server shall return a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and additional sense code shall be set to INVALID FIELD IN PARAMETER LIST.

PERSISTENT RESERVE OUT:(5Fh)

If the last valid APTPL bit value received by the controller is zero, the loss of power in the target shall release the persistent reservation for all logical units and remove all reservation keys. If the last valid APTPL bit value received by the controller is one, the logical unit shall retain any persistent reservation(s) that may be present and all reservation keys for all initiators even if power is lost and later returned.

Table 5.89 summarizes which fields are set by the application client and interpreted by the device server for each service action and scope value. The APTPL bit in the PERSISTENT RESERVE OUT parameter list, specified in the previous paragraph, is not summarized in Table 5.89.

Table 5.89 PERSISTENT RESERVE OUT Service Actions and Valid Parameters

Service Action	Allowed scope	Parameters			
		type	Reservation key	Service action reservation key	Scope-specific address
REGISTER	Ignored	Ignored	Valid	Valid	Ignored
REGISTER AND IGNORE EXISTING KEY	Ignored	Ignored	Ignored	Valid	Ignored
RESERVE	LU_SCOPE	Valid	Valid	Ignored	Ignored
	ELEMENT_SCOPE				Valid(element)
RELEASE	LU_SCOPE	Valid	Valid	Ignored	Ignored
	ELEMENT_SCOPE				Valid(element)
CLEAR	Ignored	Ignored	Valid	Ignored	Ignored
PREEMPT	LU_SCOPE	Valid	Valid	Valid	Ignored
	ELEMENT_SCOPE				Valid(element)
PREEMPT AND ABORT	LU_SCOPE	Valid	valid	Valid	Ignored
	ELEMENT_SCOPE				Valid(element)

5.11 READ:(08_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (08_H)							
	0	0	0	0	1	0	0	0
1	Logical Unit Number			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Transfer Length							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The READ command transfers to the host computer the number of consecutive data blocks from the medium specified in the transfer length field starting at the block address specified in the logical block address field. This command is used to transfer the latest data written in the specified blocks.

When a 0 is specified in the transfer length field, 256 blocks of data are transferred.

The controller terminates the command with a CHECK CONDITION status and with the “ILLEGAL REQUEST” sense key an invalid logical block address is specified (see Note). For other errors, the controller terminates the command with the CHECK CONDITION status and the appropriate sense key.

Note : The information byte field of the sense data is loaded with the last logical block address.

READ:(08h)

5.12 READ (EXTENDED):(28_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (28_H)							
	0	0	1	0	1	0	0	0
1	Logical Unit Number			DPO	FUA	Reserved		RelAdr
						0	0	0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The READ command requests the controller to transfer the number of consecutive blocks specified in the Transfer Length field to the host computer starting at the block address specified in the Logical Block Address field. This command causes the controller to transfer the latest data written on the specified blocks.

The DPO (Disable Page Out) bit is used to determine the priority of the logical block data read by this command in the cache.

But in this controller, the priority of the retained data is controlled by the value of the Retention Priority field in the mode page 8 (Caching Page; refer to Table 5.36) or the algorithm implementing the cache replacement strategy irrespective of DPO bit.

If the FUA (Force Unit Access) bit is set to 0, the controller may satisfy the command by accessing the cache.

READ (EXTENDED):(28h)

A Transfer Length of 0 specifies that no logical block is to be transferred. The controller in this case only seeks to the track containing the block specified in the Logical Block Address.

The controller terminates the command with a Check Condition status and with the “Illegal Request” Sense Key if an invalid logical block address is specified (see Note). For other errors, the controller terminates the command with the CHECK CONDITION status and the appropriate sense key.

Note : The information byte field of the sense data is loaded with the last logical block address.

5.13 READ BUFFER:($3C_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($3C_H$)							
	0	0	1	1	1	1	0	0
1	Logical Unit Number			Reserved	Mode			
				0				
2	Buffer ID							
	0	0	0	0	0	0	0	0
3	Buffer Offset (MSB)							
4	Buffer Offset							
5	Buffer Offset (LSB)							
6	Allocation Length (MSB)							
7	Allocation Length							
8	Allocation Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The READ BUFFER command transfers the data from the controller's data buffer memory to the host computer.

This command can be used in conjunction with the WRITE BUFFER command (see 5.37) as a diagnostic function for testing the controller's data buffer memory and the SCSI bus. This command does not cause the controller to access the logical unit medium.

The function of this command is determined by the Mode field as follows.

Table 5.90 Read Buffer Mode

Mode				Meaning
Bit 3	Bit 2	Bit 1	Bit 0	
0	0	0	0	Combined Header and Data
0	0	0	1	Combined Header and Data (Buffer Offset)
0	0	1	0	Data
0	0	1	1	Descriptor

(cont'd)

Table 5.90 Read Buffer Mode (cont'd)

0	1	0	0	Reserved
0	1	0	1	Reserved
0	1	1	0	Reserved
0	1	1	1	Reserved
1	0	0	0	Reserved
1	0	0	1	Reserved
1	0	1	0	Echo Buffer
1	0	1	1	Echo Buffer Descriptor
1	1	0	0	Reserved
1	1	1	1	Reserved

The controller does not use the Buffer ID field (ignored).

The Buffer Offset specifies the leading buffer address to begin the data transfer.

The Allocation Length specifies the maximum number of bytes which the host computer allocated to the data to be transferred during the DATA IN phase. The controller will not transfer more data than that specified in the Allocation Length. When an Allocation Length is specified to 0, no data is transferred. The controller does not consider this condition as an error.

The controller terminates the DATA IN phase when it has transferred the data of the Allocation Length or all the data available, whichever is less.

The Buffer Offset and Allocation Length fields must be set aligned on four-byte boundaries. If these fields do not be set aligned on four-byte, READ BUFFER command will be terminated with a CHECK CONDITION status, a sense key of ILLEGAL REQUEST.

(1) Combined Header and Data
In this mode, the 4-byte header (see Table 5.91) is transferred first and the data is subsequently transferred starting from the leading edge of the buffer.
The Buffer Offset must be specified to 0.

(2) Combined header and Data (Buffer Offset)
In this mode, the 4-byte header (see Table 5.91) is transferred first and the data is subsequently transferred starting from the address as specified in the Buffer Offset field.

READ BUFFER:(3Ch)

(3) Data
In this mode, a header is not transferred but the data is transferred starting from the address as specified in the Buffer Offset field.

(4) Descriptor
In this mode, the 4-byte Read Buffer Descriptor (see Table 5.92) is Transferred. The Buffer Offset must be specified to 0 and the Allocation Length must be specified to 4 or more.

(5) Echo Buffer
In this mode, transfer the same data as when the WRITE BUFFER command with the mode field set to echo buffer was issued.

(6) Echo Buffer Descriptor
In this mode, the 4-byte Echo Buffer Descriptor (see Table 5.93) is Transferred.

Table 5.91 Read Buffer Header

Byte	READ BUFFER Header							
0	Reserved							
	0	0	0	0	0	0	0	0
1	Buffer Capacity (MSB)							
2	Buffer Capacity							
3	Buffer Capacity (LSB)							

The Buffer Capacity indicates the maximum length of the READ BUFFER data (i.e., the length is from Buffer Offset to the last address of Buffer. And if the Buffer Offset is set to 0, the length is equal to the buffer size.) that the controller may transfer to the host computer.

It is recommended that the host computer issues the RESERVE command to this controller prior to the WRITE BUFFER command and that it issue the RELEASE command after the READ BUFFER command is completed, to avoid corruption of the controller buffer by other host computers.

Table 5.92 Read Buffer Descriptor

Byte	Read Buffer Descriptor							
0	Offset Boundary							
	0	0	0	0	0	0	1	0
1	Buffer Capacity (MSB)							
2	Buffer Capacity							
3	Buffer Capacity (LSB)							

The Offset Boundary is set to 02_H and indicates that the four-byte boundaries assignment is possible as a Buffer Offset.

The Buffer Capacity indicates the maximum buffer size.

Table 5.93 Echo Buffer Descriptor

Byte	Echo Buffer Descriptor							
0	Reserved							EBOS
	0	0	0	0	0	0	0	1
1	Reserved							
	0	0	0	0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Buffer Capacity							

The EBOS (Echo Buffer Overwritten Supported) bit displays whether the data transmitted in the Echo Buffer Mode receives influence in an Echo Buffer from other hosts.

The controller holds echo buffer data for every hosts, it indicates “1” on EBOS bit.

The Buffer Capacity indicates the maximum echo buffer size.

READ BUFFER:(3Ch)

5.14 READ CAPACITY:(25_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (25_H)							
	0	0	1	0	0	1	0	1
1	Logical Unit Number			Reserved				RelAdr
				0	0	0	0	0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Reserved							
	0	0	0	0	0	0	0	0
8	Vendor Unique		Reserved					PMI
	0	0	0	0	0	0	0	
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The READ CAPACITY command requests the controller to transfer the data concerning the logical unit capacity to the host computer.

The PMI (Partial Medium Indicator) bit of 0 indicates that the logical block address and block length of the last logical block on the logical unit are to be transferred to the host computer. In this case, the Logical Block Address in the CDB must be 0. If this condition is violated, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

The PMI bit of 1 specifies that the controller is to transfer to the host computer the logical block address and block length of the last logical block starting from the specified Logical Block Address in the CDB (including the address itself), after which a substantial delay in data transfer will be encountered.

The delay by interleave or by accessing the sector reassigned using sector slipping for bad sector alternation is not regarded as substantial.

The controller transfers the eight bytes of read capacity data shown in Table 5.94 in the Data In phase of the command.

Table 5.94 Read Capacity Data

Byte	Read Capacity Data
0	Logical Block Address (MSB)
1	Logical Block Address
2	Logical Block Address
3	Logical Block Address (LSB)
4	Block Length (MSB)
5	Block Length
6	Block Length
7	Block Length (LSB)

The Block Length field indicates the length in bytes of the logical block length.

READ CAPACITY:(25h)

5.15 READ DEFECT DATA:(37_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (37_H)							
	0	0	1	1	0	1	1	1
1	Logical Unit Number			Reserved				
				0	0	0	0	0
2	Reserved			P	G	Defect List Format		
	0	0	0					
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The READ DEFECT DATA command requests the controller to transfer the defect data of the medium to the host computer.

The Defect List Format field contains the same information as that specified in the byte 1, bits 0-2 of the FORMAT UNIT command.
The host computer can specify in this field the format of the defect list to be transferred from the controller.

Table 5.95 Defect List Format

No	Bit			Defect List Format
	2	1	0	
1	0	X	X	Block Format
2	1	0	0	Bytes from Index Format
3	1	0	1	Physical Sector Format

Note 1 : X denotes a don't care condition.

READ DEFECT DATA:(37h)

The P (Primary) bit set to 1 specifies that the controller is to return the primary list of defects. The P bit of 0 specifies that the controller must not return the primary list of defects.

The G (Grown) bit set to 1 specifies that the controller is to return the grown list of defects. The G bit of 0 specifies that the controller must not return the G list of defects.

When both P and G bits are set to 1 simultaneously, the controller returns the P and G lists in that order.
When both P and G bits are set to 0 simultaneously, the controller returns only the defect list header.

The Allocation Length field specifies the number of bytes that the host computer has allocated for returned Read Defect data. An allocation length of 0 specifies that no Read Defect data is to be transferred. The controller does not consider this condition as an error. Any other allocation length value specifies the maximum number of bytes that must be transferred. The controller terminates the Data In phase when the number of bytes specified in the Allocation Length field have been transferred or all available Read Defect data have been transferred to the host computer, whichever is less.

The Read Defect data consists of a 4-byte header, followed by zero or more defect descriptors.

Table 5.96 Read Defect Header

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
	0	0	0	0	0	0	0	0
1	Reserved			P	G	Defect List Format		
	0	0	0					
2	Defect List Length (MSB)							
3	Defect List Length (LSB)							

The P and G bits are loaded with the same values that are stored in the CDB. The Defect List Format field is loaded with the format of the defect descriptor.

The Defect List Length field specifies the total length in bytes of the subsequent defect descriptors. This field = 0 specifies that no defect descriptor is to be transferred.

READ DEFECT DATA:(37h)

The Defect List Length field indicates a value that is four times larger than the number of defect descriptors for the block format and eight times larger than the number of defect descriptors for the byte format from index or the physical sector format, irrespective of the value of the Allocation Length value.

See Table 5.3, Table 5.4 and Table 5.5 in the subsection entitled “FORMAT UNIT” for the defect descriptors.

The defect descriptor format for which the P lists are returned by this controller is in the ascending order of the address (w/o case block format) but the defect descriptor format for which the G lists are returned by this controller may not be in the ascending order of the address.

The block addresses in the block format are physical block addresses.
The physical block address is defined in Note 3 of Table 5.1.

Since the detection and registration method can be different per each defect list format used, the number of defects transferred to the host can be different.

5.16 READ DEFECT DATA(12) :($B7_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($B7_H$)							
	1	0	1	1	0	1	1	1
1	Reserved			P	G	Defect List Format		
	0	0	0					
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Allocation Length (MSB)							
7	Allocation Length							
8	Allocation Length							
9	Allocation Length (LSB)							
10	Reserved							
	0	0	0	0	0	0	0	0
11	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The READ DEFECT DATA(12) command is the same as the READ DEFECT DATA command except that the READ DEFECT DATA(12) command has 4-byte length of Allocation Length and 8-byte length of Read Defect Header as follows.

Refer to item 5.15 READ DEFECT DATA command in detail.

READ DEFECT DATA(12) :(B7h)

Table 5.97 Read Defect Header

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							
	0	0	0	0	0	0	0	0
1	Reserved			P	G	Defect List Format		
	0	0	0					
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Defect List Length (MSB)							
5	Defect List Length							
6	Defect List Length							
7	Defect List Length (LSB)							

READ DEFECT DATA(12) :(B7h)

5.17 READ LONG:($3E_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($3E_H$)							
	0	0	1	1	1	1	1	0
1	Logical Unit Number			Reserved			CORRCT	RelAdr
				0	0	0		0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Byte Transfer Length (MSB)							
8	Byte Transfer Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The READ LONG command transfers the data and CRC/ECC bytes of the block specified in Logical Block Address to the host computer.
The data transferred to the host computer may contain sets of data which consist of user data bytes (block length) , CRC/ECC bytes etc.

The CORRCT (Corrected) bit of 0 indicates that the controller transfers data starting at the block address specified in the Logical Block Address field without ECC correction.
The CORRCT bit of 1 indicates that the controller transfers data after executing ECC correction.
The Byte Transfer Length specifies the total number of transfer bytes of data bytes (block length) and other information bytes (CRC/ECC etc.).
Byte Transfer Length of 0 indicates that no data is transferred. The controller executes only seek operation to the track including the block specified by Logical Block Address.

READ LONG:(3Eh)

If the incorrect value is specified in Byte Transfer Length, the controller returns CHECK CONDITION status with ILLEGAL REQUEST sense key. The ILI and Valid bits are set to 1, and the difference of the requested length minus the actual length in bytes is set to Information Byte. The negative values are indicated by two's complement notation.
The host computer can calculate the correct Byte Transfer Length by subtracting the Information Byte from the incorrect Byte Transfer Length.

READ LONG:(3Eh)

5.18 REASSIGN BLOCKS:(07_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (07_H)							
	0	0	0	0	0	1	1	1
1	Logical Unit Number			Reserved				
				0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The REASSIGN BLOCKS command reassigns the defective logical blocks using alternate spare sectors.

The host computer transfers a defect list containing the logical block addresses to be reassigned. The controller reassigns the physical blocks specified for each logical block address in the list. The data contained the logical blocks specified in the list are altered but the data in the other logical blocks are preserved.

If logical blocks that has previously been reassigned are specified for reassignment, they are assigned again.

If there is insufficient alternate spare area for reassigning the all specified defective logical blocks, the controller reassigns as any blocks as it can, terminates the command with a CHECK CONDITION status, and sets the sense key to "HARDWARE ERROR". The controller sets the block address of the first unassigned logical block in the command specific bytes of the sense data.

The Reassign Blocks defect list (Table 5.98) is loaded with a 4-byte header, followed by one or more defect descriptors.
Each defect descriptor is four bytes long.

Table 5.98 Reassign Blocks Defect List

Byte	Defect List Header							
0	Reserved							
	0	0	0	0	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	Defect List Length (MSB)							
3	Defect List Length (LSB)							
Byte	Defect Descriptor (s)							
0	Defect Logical Block Address (MSB)							
1	Defect Logical Block Address							
2	Defect Logical Block Address							
3	Defect Logical Block Address (LSB)							

The defect list length specifies the total length in bytes of the subsequent defect descriptors. This value may be zero.
In this case, no defect descriptor is transferred from the host computer.

The defect list length value must be four times the number of defect descriptors.
In case of 512 Bytes/Sector format , the number of defect descriptors which the host computer can specifies is 40_H as the maximum (i.e. the maximum number of defect list length is 100_H).

When no 4-byte header is transferred or when an invalid defect list length is specified, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

Each defect descriptor specifies the 4-byte defect block address of the block containing a defect. The host computer must send the defect descriptors in the ascending order of address.

If a block address exceeding the maximum address allowed for the drive is specified, or if the detect block addresses are not in the ascending order, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

REASSIGN BLOCKS:(07h)

The defects specified in the REASSIGN BLOCKS command are added to the G list (Grown Defect List) at the normal end of this command.

Precautions on the host computer side;

When the information bytes of the sense data are reported as valid (Valid bit = 1), the host computer should issue another Reassign Blocks command with the reported block address added to the defect descriptors.

When the sense data is received with the logical block address (except $FFFFFFFF_H$) in the command specific bytes, the host computer should issue another Reassign Blocks command with the defect descriptors removed the defect blocks of less local block address number than the reported one.

5.19 RECEIVE DIAGNOSTIC RESULTS:($1C_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($1C_H$)							
	0	0	0	1	1	1	0	0
1	Logical Unit Number			Reserved				
				0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Allocation Length							
4	Allocation Length							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The RECEIVE DIAGNOSTIC RESULTS command requests the controller to return the results of the SEND DIAGNOSTIC command (see 5.29) to the host computer whose SelfTest bit is set to 0. The results of the diagnostics are unpredictable if the SelfTest bit is set to 1.

The Allocation Length field specifies the number of bytes that the host computer has allocated for returned diagnostic data. An allocation length of 0 specifies that no diagnostic data is to be transferred.
This condition must not be considered as an error. Any other allocation length value specifies the maximum number of bytes that must be transferred. The controller terminates the Data In phase when the number of bytes specified in the Allocation Length field have been transferred or when all available diagnostic data have been transferred to the host computer, whichever is less.

The diagnostic data is described in the description on the SEND DIAGNOSTIC command. (See 5.29)

5.20 RELEASE:(17_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (17_H)							
	0	0	0	1	0	1	1	1
1	Logical Unit Number			3rdPty	Third Party Device ID			Extent
								0
2	Reservation Identification							
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The RELEASE command releases a logical unit that is previously reserved by a host computer. No error must be informed if a RELEASE command is issued to a logical unit that is not reserved.

The Extent bit must always be set to 0 as this SCSI controller does not support the extent release feature. If this condition is violated, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

The controller ignores the Reservation Identification that is used by the extent release feature.

(1) Logical unit release

The RELEASE command releases the logical unit that is reserved by the current host computer.

(2) Third party release

The third-party release feature of the Release command allows the host computer to release a logical unit that is reserved by the third party reservation feature.

When the 3rdPty (Third Party) bit is set to 0, the third party release feature is disabled. In this case, the controller ignores the Third Party Device ID field.

When the 3rdPty bit is set to 1, the controller releases the logical unit from the reserved state provided that the reservation has been carried out by the same host computer on the same SCSI device specified in the Third Party Device ID field.

The Third Party Device ID field contains the SCSI ID for the SCSI device to release the logical unit.

5.21 RELEASE(10):(57_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (57_H)							
	0	1	0	1	0	1	1	1
1	Logical Unit Number			3rdPty	Reserved			Extent
					0	0	0	0
2	Reservation Identification							
3	Third Party Device ID							
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Parameter List Length(MSB)							
8	Parameter List Length(LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The RELEASE(10) command is the same as the RELEASE command (see 5.20) expect that the RELEASE(10) command has 1-byte length of Third Party Device ID.

If the RELEASE(10) command is implemented, then the RESERVE(10) also shall be implemented.

RELEASE(10):(57h)

5.22 REPORT LUNS:(A0h)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code($A0_H$)							
	1	0	1	0	0	0	0	0
1	Logical Unit Number			Reserved				
				0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Allocation Length(MSB)							
7	Allocation Length							
8	Allocation Length							
9	Allocation Length(LSB)							
10	Reserved							
	0	0	0	0	0	0	0	0
11	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The REPORT LUNS command reports the logical unit number which the controller is supporting by REPORT LUNS parameter list(see).

The allocation length should be at least 16 bytes. If the allocation length is not sufficient to contain the entire logical unit inventory, the host computer shall report as many logical unit number values as fit in the specified allocation length. This shall not be considered an error.

Note : Devices compliant with SPC return CHECK CONDITION status with sense key ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB when the allocation length is less than 16 bytes.

REPORT LUNS:(A0h)

Table 5.99 REPORT LUNS Parameter List Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)							
•	LUN List Length(N-7)							
•								
3								(LSB)
4	Reserved							
•								
•								
7								
LUN List								
8	(MSB)							
•	First LUN							
•								
15								(LSB)
•	•							
•	•							
•	•							
N-7	(MSB)							
•	Last LUN							
•								
N								(LSB)

The controller supports only the logical unit number 0, first LUN in LUN list 0000000000000000_H are reported.

REPORT LUNS:(A0h)

5.23 REQUEST SENSE:(03_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (03_H)							
	0	0	0	0	0	0	1	1
1	Logical Unit Number			Reserved				
				0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Allocation Length							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The REQUEST SENSE command returns the sense data of the unit describing the CHECK CONDITION status indicated to the host computer. The sense data is held pending in the controller so that it may be transferred to the host computer.
This sense data is cleared when the unit in the check state receives a new command from the host computer that received the CHECK CONDITION status.

The allocation length specifies the number of bytes to be allocated by the host computer for the sense data to be transferred. The other allocation length values specify the maximum number of bytes to be transferred. The controller terminates the Data In phase when it has transferred the number of sense data bytes specified by the allocation length or all sense data bytes, whichever is shorter.

This command returns the Check Condition status only when one of the following fatal errors occurs

· The controller receives a non-zero reserved bit n the CDB.

· The controller detects an unrecoverable parity error on the data bus.

· The sense data transfer is prevented by a controller error.

The sense data transferred when a fatal error occurred during a REQUEST SENSE command is invalid.

The sense data transferred by this SCSI controller is all in the extended sense format (see Chapter 6, "**SENSE DATA**" for the extended sense data).

REQUEST SENSE:(03h)

5.24 RESERVE:(16_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (16_H)							
	0	0	0	1	0	1	1	0
1	Logical Unit Number			3rdPty	Third Party Device ID			Extent
								0
2	Reservation Identification							
3	Extent List Length (MSB)							
4	Extent List Length (LSB)							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The RESERVE command reserves a logical unit for the host computer issuing this command. The third-party reservation feature allows the logical unit to be reserved for another specified SCSI device.

The RESERVE and RELEASE commands provide the basic mechanism for resolving contentions that can occur in multi-host (initiator) systems.

Since this SCSI controller does not support the extended reservation feature, the Extent bit must always be set to 0. If this is not observed, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

The controller ignores the Reservation Identification and Extent List Length fields that are used by the extent reservation feature. Accordingly, no Data Out phase can occur.

(1) Logical unit reservation

The RESERVE command requests the controller to reserve the specified logical unit so that the host computer can use the entire logical unit exclusively until the reservation is superseded by another valid RESERVE command issued by the same host computer or until the reservation is released by a RELEASE command from the same host computer, by a Bus Device Reset message from another host computer, or by a hardware reset.

A logical unit reservation is rejected with the RESERVATION CONFLICT status set if the specified logical unit has already been reserved by another host computer. In this case, the reservation request is not queued into the controller (the RESERVE command itself is queued, however).

The host computer can reserve any logical unit that has been reserved by the same host computer.
Once a reservation is established, if another host computer issues a command other than the INQUIRY, REQUEST SENSE or RELEASE command to the reserved logical unit, that command is rejected with the RESERVATION CONFLICT status set.

(2) Third party reservation

The third-party reservation feature of the RESERVE command allows the host computer to reserve a logical unit for another specified SCSI device. This feature is applicable to multi-host systems that use the COPY command. (The COPY command proper is executed by another SCSI controller.)

Third party reservation is disabled when the 3rdPty (Third Party) bit is set to 0. In this case, the controller ignores the Third Party Device ID field.

When the 3rdPty bit is set to 1, the controller reserves the logical unit for another SCSI device specified in the Third Party Device ID field.

The Third Party Device ID field contains the SCSI ID for another SCSI device to be reserved as the logical unit.

Third Party reservation processing proceeds in the same way as in logical unit reservation except that it allows another SCSI device to reserve the logical unit.

This SCSI controller releases a third party reservation when it receives a valid RESERVE command from the same host computer (superseding reservation), when it receives a third party Release command specifying the same third party device ID, when it receives a BUS DEVICE RESET message from any host computer, or when a hardware reset condition occurs.

(3) Superseding reservation

The host computer that retains a logical unit reservation can change the reservation status by issuing another RESERVE command. This superseding RESERVE command releases the old reservation state when the new reservation request is allowed. If the new reservation request is not accepted, the old reservation state is preserved. If the superseding reservation conflicts with the preceding active reservation state (other than
the reservation being superseded), the controller rejects this command with the RESERVATION CONFLICT status.

The primary purpose of superseding reservation is to change the SCSI device ID in the third party reservation state.
This feature is made available for the COPY command that is used between different SCSI devices.

RESERVE:(16h)

5.25 RESERVE(10):(56_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (56_H)							
	0	1	0	1	0	1	1	1
1	Logical Unit Number			3rdPty	Reserved			Extent
					0	0	0	0
2	Reservation Identification							
3	Third Party Device ID							
4	Reserved							
	0	0	0	0	0	0	0	0
5	Reserved							
	0	0	0	0	0	0	0	0
6	Reserved							
	0	0	0	0	0	0	0	0
7	Extent List Length (MSB)							
8	Extent List Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The RESERVE(10) command is the same as the RESERVE command expect that the RESERVE(10) command has 1-byte length of Third Party Device ID.

If the RESERVE(10) command is implemented, then the RELEASE(10) also shall be implemented.

RESERVE(10):(56h)

5.26 REZERO UNIT:(01_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (01_H)							
	0	0	0	0	0	0	0	1
1	Logical Unit Number			Reserved				
				0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The REZERO UNIT command is used to recover from errors such as seek errors occurring in the selected disk drive. This error recovery command positions the read/write head in the home position (physical cylinder 0, head 0).

5.27 SEEK:($0B_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($0B_H$)							
	0	0	0	0	1	0	1	1
1	Logical Unit Number			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Reserved							
	0	0	0	0	0	0	0	0
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The SEEK command positions the read/write head on the track containing the block that is specified in the logical block address field.

The controller terminates the command with a CHECK CONDITION status and with the “ILLEGAL REQUEST” sense key if an invalid logical block address is specified (see Note). For other errors, the controller terminates the command with the CHECK CONDITION status and the appropriate sense key.

Note : The information byte field of the sense data is loaded with the last logical block address.

5.28 SEEK (EXTENDED):($2B_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($2B_H$)							
	0	0	1	0	1	0	1	1
1	Logical Unit Number			Reserved				
				0	0	0	0	0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Reserved							
	0	0	0	0	0	0	0	0
8	Reserved							
	0	0	0	0	0	0	0	0
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The Seek command positions the read / write head on the track containing the block that is specified in the Logical Block Address field.

The controller terminates the command with a CHECK CONDITION status and with the “ILLEGAL REQUEST” sense key if an invalid logical block address is specified (see Note). For other errors, the controller terminates the command with the CHECK CONDITION status and the appropriate sense key.

Note : The information byte field of the sense data is loaded with the last logical block address.

5.29 SEND DIAGNOSTIC:($1D_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($1D_H$)							
	0	0	0	1	1	1	0	1
1	Self-Test Code			PF	R	SelfTest	DevOfL	UnitOfL
					0		0	
2	Reserved							
	0	0	0	0	0	0	0	0
3	Parameter List Length (MSB)							
4	Parameter List Length (LSB)							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The SEND DIAGNOSTIC command requests the controller to perform diagnostics on the controller and the selected logical unit.

When the SelfTest bit is one the Self-Test Code field shall contain (000)b. When the SelfTest bit is zero, the contents of Self-Test Code field are specified in Table 5.100.

Table 5.100 Self-Test Code Field Values

Self-Test Code	Name	Description
(000)b	-	This value shall be used when the SelfTest bit is set to one or if the SEND DIAGNOSTIC command is not invoking one of the other self-test functions such as enclosure services(see SES) or the Traslate Address page.
(001)b	Background short self-test	The device server shall start its short self-test in the background mode. The Parameter List Length field shall contain zero.
(010)b	Background extended self-test	The device server shall start its extended self-test in the background mode. The Parameter List Length field shall contain zero.
(011)b	Reserved	

(cont'd)

Table 5.100 Self-Test Code Field Values (cont'd)

(100)b	Abort background self-test	The device server shall abort the current self-test running in background mode. The Parameter List Length field shall contain zero. This value is only valid if a previous SEND DIAGNOSTIC command specified a background self-test function and that self-test has not completed. If either or these conditions is not met, then the device server shall return a CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.
(101)b	Foreground short self-test	The device server shall start its short self-test in the foreground mode. The Parameter List Length field shall contain zero.
(110)b	Foreground extended self-test	The device server shall start its extended self-test in the foreground mode. The Parameter List Length field shall contain zero.
(111)b	Reserved	

The controller carries out the default self-diagnostics if the SelfTest (Self Test) bit of the command is set to 1. In this case, the Parameter List Length field must be set to 0.
When the self-diagnostics are completed normally, the controller terminates the command with the GOOD status. Otherwise, the controller terminates the command with a CHECK CONDITION status and sets the sense key to "HARDWARE ERROR" .
The results of the self-diagnostics are not returned to the host computer responding to the RECEIVE DIAGNOSTIC RESULTS command. (see 5.19)

When the SelfTest bit is set to 0, the controller carries out the diagnostics specified in the diagnostic parameters (listed in Table 5.101).

If the DevOfL (SCSI Device Offline) bit is set to 1, the controller is allowed to have a bad influence on operations to other logical unit on the controller.
If the DevOfL bit is set to 0, the information of operations to other logical unit on the controller is preserved. The controller only supports DevOfL bit = 0.
The PF (Page Format) bit of 1 specifies that diagnostic parameters are defined in page format. The PF bit of 0 specifies that diagnostic parameters are not defined in page format (they are defined in vender unique format).

When the UnitOfL (Logical Unit Offline) bit is set to 1, the controller performs diagnostics that enables write operations on user medium or operation that affect user visible medium positioning.
When the UnitOfL bit is set to 0, the diagnostics that enables write operations on user medium or operations that affect user visible medium positioning are inhibited.

The Parameter List Length field specifies the length in bytes of the diagnostic parameters to be transferred during the Data Out phase.
The host computer must set this field to 0 if the SelfTest bit is set to 1. If the SelfTest bit is set to 0, the Parameter List Length field must be set to a value greater than or equal to 6_H. If this condition is not met, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

The contents of diagnostic parameter list are written in (1) Page Format diagnostic parameter and (2) Vender Unique diagnostic parameter.

(1) Page Format diagnostic parameter

The diagnostic parameters commonly used by the Send Diagnostic and Receive Diagnostic Results commands are shown in Table 5.101, defined when the PF bit is set to 1.

For the Send Diagnostic command, the Parameter List Length specifies the number of diagnostic parameter bytes. The Parameter List Length of 0 indicates that no diagnostic parameter is transferred. The controller does not handle this condition as an error (no operation). The host computer may transfer one page of data as a diagnostic parameter.

If any shortage of parameters or multiple-page transfer occurs, the controller returns the CHECK CONDITION status with ILLEGAL REQUEST sense key.

For the Receive Diagnostic Results command, the Allocation Length specifies the number of diagnostic parameter bytes.

Table 5.101 Diagnostic Page Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code							
1	Reserved							
	0	0	0	0	0	0	0	0
2	Page Length (MSB)							
3	Page Length (LSB)							
4 to n	Diagnostic Parameters							

The Page Code specifies either specification (in case of Send Diagnostic command) or report (in case of Receive Diagnostic Results command). The controller supports the following pages.

Page Code	Description
00_H	Supported Diagnostic Page
40_H	Translate Address Page

When any other page code than shown above is specified, the controller returns CHECK CONDITION status with the ILLEGAL REQUEST sense key.

The Page Length specifies the number of bytes that follow the Page Length field.

SEND DIAGNOSTIC:(1Dh)

Table 5.102 Supported Diagnostic Page (Code = 00_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code							
	0	0	0	0	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	Page Length (MSB)							
	0	0	0	0	0	0	0	0
3	Page Length (LSB)							
	0	0	0	0	0	1	0	0
Supported Page List								
4	00_H (Supported Diagnostic)							
5	40_H (Translate Address)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Reserved							
	0	0	0	0	0	0	0	0

For the Send Diagnostic command, the Page Length must be specified to 0. If any value other than 0 is specified, the controller returns the Check Condition status with the Illegal Request Sense Key.

For the Receive Diagnostic Results command, the controller sets the Page Length to 0004_H and reports the codes 00_H (Supported Diagnostic Page) and 40_H (Translate Address Page).

SEND DIAGNOSTIC:(1Dh)

Table 5.103 Translate Address Page (Code = 40_H)

(in case of Send Diagnostic command)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code							
	0	1	0	0	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	Page Length (MSB)							
	0	0	0	0	0	0	0	0
3	Page Length (LSB)							
	0	0	0	0	1	0	1	0
4	Reserved					Supplied Format		
	0	0	0	0	0			
5	Reserved					Translate Format		
	0	0	0	0	0			
6 to 13	Address to Translate							

The Page Length must be set to $000A_H$. If any value other than $000A_H$ is set, the controller returns the Check Condition status with the Illegal Request Sense Key.

The selectable combination of Supplied Format (before translation) and Translate Format (after translation) is shown as below.

Table 5.104 Translation Format

Supplied Format		Translate Format	
Code	Format	Code	Format
0XX	Logical Block Address	101	Physical Sector Address
101	Physical Sector Address	0XX	Logical Block Address

(Note) A bit of X denotes “do not care” condition.

The above codes are identical with those of the Defect List Format in the Format Unit command (see 5.1). But the sector number shown in the Physical Sector Address has no fixed relation to the physical location from the index signal since the controller uses ID information on this sector.

If any other translation than defined above is specified, the controller returns the Check Condition with the Illegal Request Sense Key.

SEND DIAGNOSTIC:(1Dh)

When the Supplied Format is the Logical Block Address, the byte 6 to 9 of Address to Translate field specifies a logical block address in Block Format (see Table 5.3 in Format Unit command). The byte 10 to 13 of the field must be set to 00000000_H.

When the Supplied Format is the Physical Sector Address, the byte 6 to 13 of Address to Transfer field specifies a physical block address in Physical sector Format (see Table 5.5 in Format Unit command).

If any invalid logical block address or non-zero value of byte 10 to 13 is specified, the controller returns the Check Condition status with the Illegal Request Sense Key.

Table 5.105 Read Alternate Page (Code = 40_H)

(in case of Receive Diagnostic Results command)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Page Code							
	0	1	0	0	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	Page Length (MSB)							
3	Page Length (LSB)							
4	Reserved					Supplied Format		
	0	0	0	0	0			
5	RAREA	ALTSEC	ALTTRK	Reserved		Translated Format		
				0	0			
6 to 13	Translated Address 1							
14 to 21	Translated Address 2 (if required)							
...	...							
n to n+7	Translated Address n (if required)							

SEND DIAGNOSTIC:(1Dh)

The Page Length indicates the number of bytes that follow the Page Length field.

The Supplied Format indicates the code sent by the Send Diagnostic command.

The RAREA (Reserved Area) bit of 1 indicates that a part or the whole of address-translated block locates in the reserved area of medium (the area inaccessible by the host using logical block address).
The RAREA bit of 0 indicates that the whole address-translated block does not locate in the reserved area of medium.

The ALTSEC (Alternate Sector) bit of 1 indicates that a part or the whole of address-translated blocks is reallocated to an alternate sector in medium (except sector slipping reallocation).
The ALTSEC bit of 0 indicates that the whole of address-translated block is not reallocated to an alternate sector in medium (except sector slipping reallocation).

The ALTTRK (Alternate Track) bit of 1 indicates that a part or the whole of address-translated blocks is reallocated to an alternate track in medium.
The ALTTRK bit of 0 indicates that the whole of address-translated block is not reallocated to an alternate track in medium.

But when the sector specified by Send Diagnostic command is an original sector or a replacement sector in specified track, RAREA and ALTSEC bit values reported from the controller are indecisive.

The Translated Address 1 to n indicate the address after translation. For instance, if the logical block consists of two physical sectors, the addresses for these two sectors are indicated accordingly.

(2) Vender Unique diagnostic parameter
The diagnostic parameters whose the PF bit is set to 0 are shown in Table 5.106 and Table 5.107.

Table 5.106 Diagnostic Parameter List

Byte	Diagnostic Control Bytes
0	Sub Command Code
1-4	Refer to Sub Command Definition
5	Control Byte
Diagnostic Data	
6-n	Refer to Sub Command Definition

SEND DIAGNOSTIC:(1Dh)

The results of the diagnostics specified in the vender unique diagnostic parameters are reported to the host computer by the RECEIVE DIAGNOSTIC RESULTS command. The SEND DIAGNOSTIC command terminates with the GOOD status whether the result of diagnostics is successful or not (normal or abnormal termination).

The sub command code identifies the diagnostic function to be carried out by the controller. Some sub commands are not executed if its UnitOfL bit is set to 0.

Table 5.107 Sub Command Codes

No.	UnitOfL Bit		Sub Command Code	Function
	0	1		
1	X	X	00_H	No Operation
2		X	02_H	Read Long
3		X	03_H	Write Long
4		X	07_H	Physical Read
5		X	08_H	Physical Write

If a sub command code is specified on condition that UnitOfL bit is set to the value without X marked in Table 5.67, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.
If an invalid sub command code is specified, the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

SEND DIAGNOSTIC:(1Dh)

5.30 START / STOP UNIT:($1B_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($1B_H$)							
	0	0	0	1	1	0	1	1
1	Logical Unit Number			Reserved				Immed
				0	0	0	0	
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							Start
	0	0	0	0	0	0	0	
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The START/STOP command specifies whether the logical unit is to be made ready or not ready for the subsequent operations.

When the Immed (Immediate) bit is set to 1, the controller returns the status immediately after starting an operation (Spin Up / Down).

When the Immed bit is set to 0, the controller returns the status on completion of the operation.

When the Start bit is set to 1, the controller sets the logical unit ready.

When the Start bit is set to 0, the controller sets the logical unit not ready.

START / STOP UNIT:(1Bh)

5.31 SYNCHRONIZED CACHE:(35_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (35_H)							
	0	0	1	1	0	1	0	1
1	Logical Unit Number			Reserved			Immed	RelAdr
				0	0	0		0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The SYNCHRONIZED CACHE command requests the controller to write the unwritten data in the cache memory, within the range specified in the Transfer Length, starting at the block address specified in the Logical Block Address field., to the disk.

The Transfer Length of 0 indicates that all remaining logical blocks on the logical unit shall be within the range.

If the Immed (Immediate) bit is set to 1, the controller returns GOOD status as soon as the CDB is received.
If the Immed bit is set to 0, the command terminates after the all unwritten data in the cache memory is finished writing to the medium.

5.32 TEST UNIT READY:(00_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (00_H)							
	0	0	0	0	0	0	0	0
1	Logical Unit Number			Reserved				
				0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0
4	Reserved							
	0	0	0	0	0	0	0	0
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The TEST UNIT READY command checks whether the selected drive is ready or not. The controller responds to this command with a GOOD status when the selected drive has been powered on and in the ready state (ready to write to and read from its disk storage).
Otherwise, the controller returns a status according to the drive state.

5.33 VERIFY:($2F_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($2F_H$)							
	0	0	1	0	1	1	1	1
1	Logical Unit Number			DPO	Reserved		BytChk	RelAdr
					0	0		0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Verification Length (MSB)							
8	Verification Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The VERIFY command verifies the data in the number of consecutive data blocks specified in the Transfer Length field, starting at the block address specified in the Logical Block Address field.

The DPO (Disable Page Out) bit is ignored.

When the BytChk (Byte Check) bit is set to 0, the controller does not request the verification data but verifies the written data in the medium using ECC. When the BytChk bit is set to 1, the controller performs byte-by-byte compare check between the written data in the medium and the transferred data from the host computer.

A verification Length of 0 specifies that no logical block is to be verified. The controller in this case only seeks to the track containing the block specified in the Logical Block Address.

VERIFY:(2Fh)

The controller terminates the command with a CHECK CONDITION status and with the “ILLEGAL REQUEST” sense key if an invalid logical block address is specified (see Note). For other errors, the controller terminates the command with the CHECK CONDITION status and the appropriate sense key.

Note : The information byte field of the sense data is loaded with the last logical block address.

VERIFY:(2Fh)

5.34 WRITE:($0A_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($0A_H$)							
	0	0	0	0	1	0	1	0
1	Logical Unit Number			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Transfer Length							
5	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The WRITE command writes the number of consecutive data blocks from the host computer specified in the transfer length field to the medium starting at the block address specified in the logical block address field.

When a 0 is specified in the transfer length field, 256 blocks of data are transferred.

The controller terminates the command with a CHECK CONDITION status and with the “ILLEGAL REQUEST” sense key if an invalid logical block address is specified (see Note). For other errors, the controller terminates the command with the CHECK CONDITION status and the appropriate sense key.

Note : The information byte field of the sense data is loaded with the last logical block address.

5.35 WRITE (EXTENDED):($2A_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($2A_H$)							
	0	0	1	0	1	0	1	0
1	Logical Unit Number			DPO	FUA	Reserved		RelAdr
						0	0	0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The WRITE command writes the number of consecutive data blocks from the host computer specified in the Transfer Length field to the medium starting at the block address specified in the Logical Block Address field.

The DPO (Disable Page Out) bit is used to determine the priority of the logical block data read by this command in the cache.
But in this controller, the priority of the retained data is controlled by the value of the Retention Priority field in the mode page 8 (Caching Page; refer to Table 5.36) or the algorithm implementing the cache replacement strategy irrespective of DPO bit.

If the FUA (Force Unit Access) bit is set to 1, the controller returns the status on completion of writing to the medium.
If the FUA bit is set to 0, the controller returns the status prior to writing to the medium.

A Transfer Length of 0 specifies that no logical block is to be transferred. The controller in this case only seeks to the track containing the block specified in the Logical Block Address.

WRITE (EXTENDED):(2Ah)

The controller terminates the command with a CHECK CONDITION status and with the “ILLEGAL REQUEST” sense key if an invalid logical block address is specified (see Note).

For other errors, the controller terminates the command with the CHECK CONDITION status and the appropriate sense key.

Note : The information byte field of the sense data is loaded with the last logical block address.

5.36 WRITE AND VERIFY:($2E_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($2E_H$)							
	0	0	1	0	1	1	1	0
1	Logical Unit Number			DPO	Reserved		BytChk	RelAdr
					0	0		0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The WRITE AND VERIFY command writes the number of consecutive data blocks from the host computer specified in the Transfer Length field to the medium starting at the block address specified in the Logical Block Address field, after then verify that the data is correctly written.

The DPO (Disable Page Out) bit is used to determine the priority of the logical block data read by this command in the cache.
But in this controller, the priority of the retained data is controlled by the value of the Retention Priority field in the mode page 8 (Caching Parameters; refer to Table 5.36) or the algorithm implementing the cache replacement strategy irrespective of DPO bit.

When the BytChk (Byte Check) bit is set to 0, the controller verifies the written data in the medium using ECC. When the BytChk bit is set to 1, the controller performs byte-by-byte compare check between the written data in the medium and the transferred data from the host computer.

WRITE AND VERIFY:(2Eh)

A Transfer Length of 0 specifies that no logical block is to be transferred. The controller in this case only seeks to the track containing the block specified in the Logical Block Address.

The controller terminates the command with a CHECK CONDITION status and with the “ILLEGAL REQUEST” sense key if an invalid logical block address is specified (see Note).

For other errors, the controller terminates the command with the CHECK CONDITION status and the appropriate sense key.

Note : The information byte field of the sense data is loaded with the last logical block address.

WRITE AND VERIFY:(2Eh)

5.37 WRITE BUFFER:($3B_H$)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code ($3B_H$)							
	0	0	1	1	1	0	1	1
1	Logical Unit Number			Reserved 0	Mode			
2	Buffer ID							
	0	0	0	0	0	0	0	0
3	Buffer Offset (MSB)							
4	Buffer Offset							
5	Buffer Offset (LSB)							
6	Parameter List Length (MSB)							
7	Parameter List Length							
8	Parameter List Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The WRITE BUFFER command writes the data from the host computer into the data buffer memory in the controller. This command is also used for downloading of the controller microcode.

This command can be used in conjunction with the READ BUFFER command (see 5.13) as a diagnostic function for testing the controller's data buffer memory and the SCSI bus. This command does not cause the controller to access the medium on logical unit except for the case of “Device Unique mode” or “Download Microcode and Save”.

The function of this command is determined by the Mode field as follows.

WRITE BUFFER:(3Bh)

Table 5.108 Write Buffer Mode

Mode				Meaning
Bit 3	Bit 2	Bit 1	Bit 0	
0	0	0	0	Write Combined Header and Data
0	0	0	1	Write Combined Header and Data (Buffer Offset)
0	0	1	0	Write Data
0	0	1	1	Reserved
0	1	0	0	Device Unique mode
0	1	0	1	Download Microcode and Save
0	1	1	0	Reserved
0	1	1	1	Download Microcode with offsets and save
1	0	0	0	Reserved
1	0	0	1	Reserved
1	0	1	0	Echo Buffer
1	0	1	1	Reserved
1	1	1	1	Reserved

The Buffer ID field must always be set to 0 as the controller does not support this field. If this condition is violated , the controller creates the CHECK CONDITION status with ILLEGAL REQUEST sense key.

The Buffer Offset specifies the leading buffer address to be written the data.

The Parameter List Length specifies the number of bytes to be transferred during the DATA OUT phase. When a Parameter List Length is specified to 0, no data is transferred. The controller dose not consider this condition as an error.

The Buffer Offset and Parameter List Length fields must be set aligned on four-byte boundaries. If these fields do not be set aligned on four-byte, WRITE BUFFER command will be terminated with a CHECK CONDITION status, a sense key of ILLEGAL REQUEST.

(1) Write Combined Header and Data (Buffer Offset)
In this mode, the data to be written, starting at the leading edge of the buffer, is transferred following the 4 bytes of header (see Table 5.91).
The Buffer Offset must be specified to 0.

(2) Write Combined Header and Data (Buffer Offset)
In this mode, the data following the 4 bytes of header (see Table 5.91) is to be stored into the buffer starting at the address as specified in the Buffer Offset field.

WRITE BUFFER:(3Bh)

(3) Write Data
In this mode, a header is not transferred but the data is transferred into the buffer starting at the address as specified in the Buffer Offset field.

(4) Device Unique mode
In this mode, device unique motion will be executed.

(5) Download Microcode and Save
In this mode, the transferred data (Microcode) is written into the system area in the disk medium. When the download and save operation has completed normally, the controller creates the UNIT ATTENTION condition to the all initiators except that issued this command. The Buffer Offset field must always be set to 0 as the controller does not support this field. If this condition is violated , the controller creates the CHECK CONDITION status with ILLEGAL REQUEST.

(6) Download Microcode with offsets and save
In this mode, the initiator may split the transfer of the Microcode or control information via two or more WRITE BUFFER command. The Microcode written to the logical unit buffer starting at the location specified by the BUFFER OFFSET field. The controller supports 512 byte boundaries only.

(7) Echo Buffer
In this mode, the data is to be stored into the echo buffer.

Table 5.109 Write Buffer Header

Byte	WRITE BUFFER Header							
0	Reserved							
	0	0	0	0	0	0	0	0
1	Reserved							
	0	0	0	0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Reserved							
	0	0	0	0	0	0	0	0

WRITE BUFFER:(3Bh)

5.38 WRITE LONG:($3F_H$)

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code ($3F_H$)							
	0	0	1	1	1	1	1	1
1	Logical Unit Number			Reserved				RelAdr
				0	0	0	0	0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Byte Transfer Length (MSB)							
8	Byte Transfer Length (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The user data and CRC/ECC bytes transferred from the host computer are written in the block specified by Logical Block Address by WRITE LONG command. The data transferred from the host computer consists of user data bytes (block length) and CRC/ECC information bytes etc.

The Byte Transfer Length specifies the total number of transfer bytes of data byte (block length) and CRC/ECC bytes etc.
The Byte Transfer Length of 0 indicates that no data is transferred, and the controller executes only seek operation to the track including the block specified by Logical Block Address.
If the incorrect value is specified in Byte Transfer Length, the controller returns CHECK CONDITION status with ILLEGAL REQUEST sense key.

The ILI and Valid bits of the sense data are set to 1, and the difference of the requested length (Byte Transfer Length) minus the actual length (block length + CRC/ECC bytes etc.) in bytes is set to Information Byte.
The negative values are indicated by two's complement notation.

5.39 WRITE SAME:(41_H)

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (41_H)							
	0	1	0	0	0	0	0	1
1	Logical Unit Number			Reserved		PBdata	LBdata	RelAdr
				0	0	0	0	0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
	0	0	0	0	0	0	0	0
7	Number of Blocks (MSB)							
8	Number of Blocks (LSB)							
9	Vendor Unique		Reserved				Flag	Link
	0	0	0	0	0	0		

The WRITE SAME command requests the controller to write a block of data transferred from the host into multiple blocks in the medium.

The PBdata (Physical Block Data) bit is not supported by the controller and, therefore, must be set to 0.

The LBdata (Logical Block Data) bit is not supported by the controller and therefore, must be set to 0.

The Logical Block Address specifies the starting logical block to write by this command.

The Number of Blocks specifies the number of consecutive logical blocks to be written.

The Number of Blocks of 0 specifies to continue writing till the last available logical block.

WRITE SAME:(41h)

6 SENSE DATA

The sense data is transferred to the host computer through the REQUEST SENSE command (Refer to 5.23).

6.1 SENSE DATA FORMAT

This SCSI controller supports only the extended sense data format.
The extended sense data format is shown in Table 6.1.

The Error Code 70_H (Current Error) or Error Code 71_H (Deferred Error) are supported by this controller.

Table 6.1 Extended Sense Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0	Valid	Error Code						
1	Segment Number							
	0	0	0	0	0	0	0	0
2	FileMark	EOM	ILI	R	Sense Key			
	0	0		0				
3	Information Byte (MSB)							
4	Information Byte							
5	Information Byte							
6	Information Byte (LSB)							
7	Additional Sense Length							
	0	0	0	1	1	0	0	0
8-11	Command-Specific Information							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	FRU Code							
	0	0	0	0	0	0	0	0

(cont'd)

Table 6.1 Extended Sense Data Format(cont'd)

15	SKSV	
16	Sense-Key Specific	
17	Sense-Key Specific	
18 to 31	Additional Sense Bytes	

A Valid bit of 1 indicates that the information bytes have been established. A Valid bit of 0 indicates that no information bytes are established.

The Segment Number field is not used and always indicates 00_H.

The Filemark bit is not used and always set to 0.

The EOM (End of Medium) bit is not used and always set to 0.

The ILI (Incorrect Length Indicator) bit is set to 1, if the incorrect value is specified in Byte Transfer Length field at READ LONG or WRITE LONG command.
In other cases, 0 is indicated.

The Sense Key provides the error status information or the exception condition information. The details of these information are listed in Table 6.2..

The information byte is valid when the Valid bit is set to 1 and the logical block address associated with the sense key is indicated. The information byte regarding FORMAT UNIT, READ LONG or WRITE LONG command is to be referred to the each command description, 5.1, 5.17 or 5.38 respectively.

The Additional Sense Length indicates the number of subsequent sense byte, 24 (18_H), which indicates that sense data is 32 bytes.

The Command-Specific Information field indicates the leading logical block address which could not be reassigned by a REASSIGN BLOCKS command. In other cases, 00000000_H is indicated.

The Additional Sense Code(ASC) provides the further detail information describing the sense key and the Additional Sense Code Qualifier(ASCQ) provides the detail information added to the Additional Sense Code. The details of these information are given in Table 6.3.

The FRU (Field Replaceable Unit Code) code is not used and always set to 00_H.

When the SKSV (Sense-Key Specific Valid) bit is set to 0, it indicates that the Sense-Key Specific-field is undetermined.

When the SKSV bit is set to 1, the contents of the Sense-Key Specific field is validated and varies the definition depending on the sense key.

(1) When the sense key is ILLEGAL REQUEST (5_H), the definition is as shown in Table 6.4.

(2) When the sense key is RECOVERED ERROR (1_H), MEDIUM ERROR (3_H) or HARDWARE ERROR (4_H), the definition is as shown in Table 6.5.

(3) When the sense key is NOT READY (2_H), the definition is as shown in Table 6.6.

The Additional Sense Bytes (Byte 18 to 31) indicates the detail error information.

Table 6.2 Sense Keys

Sense Key	Meaning
0_H	**NO SENSE** : Indicates that there is no specific sense key information to be reported from the specified logical unit. This key indicates that the command has been terminated successfully.
1_H	**RECOVERED ERROR** : Indicates that the last command has been terminated successfully after some recovery procedure performed by the controller. The details may be found in the additional sense bytes and information bytes.
2_H	**NOT READY** : Indicates that the addressed logical unit is not accessible. An operator intervention may be required to recover from this condition.
3_H	**MEDIUM ERROR** : Indicates that the command has been terminated due to an unrecoverable error caused by a flaw on the medium or an error in the recorded data.

(cont'd)

Table 6.2 Sense Keys (cont'd)

4_H	**HARDWARE ERROR** : Indicates that the controller has detected an unrecoverable hardware error(e.g., controller failure, device failure, parity error, etc.) during the execution of a command or self-test.
5_H	**ILLEGAL REQUEST** : Indicates that illegal data has been found in the command descriptor block or an additional parameter which is specified as data for some commands (e.g., FORMAT UNIT, MODE SELECT, etc.). When the controller detects an invalid parameter in the CDB, it terminates the command without updating the medium. When an invalid parameter is found in an additional parameter that is given as data, however, the medium may have been already updated.
6_H	**UNIT ATTENTION** : Indicates that a Unit Attention condition (see 3.1.4) has been created by a change in a Mode Select Parameter or the controller being reset.
7_H	**DATA PROTECT** : Indicates that the controller has received a WRITE command when the medium is protected against write operations. The controller carried out no write operation.
8_H	**BLANK CHECK**. (Not used.)
9_H	**Vendor Unique**. (Not used.)
A_H	**COPY ABORTED** (Not used.)
B_H	**ABORTED COMMAND** : Indicates that the controller has aborted the command. The host computer can recover from this condition by issuing the command again.
C_H	**EQUAL**. (Not used.)
D_H	**VOLUME OVERFLOW** (Not used.)
E_H	**MISCOMPARE** : Indicates that a data compare of the byte compare verification was unsuccessful.
F_H	Reserved

The valid combinations of the Sense Key, Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ are described in the following Table 6.3. Note that all Sense Key, ASC and ASCQ in Table 6.3 are hex values.

Table 6.3 Additional Sense Codes & Qualifiers

Sense Key	ASC	ASCQ	Error name	Meaning
0	00	00	No Additional Sense Information	No valid additional sense information is present.
4	01	00	No Index/Sector Signal	No Index signal could be detected. No Sector signal could be detected.
1 or 4	02	00	No Seek Complete	The drive seek was not completed successfully.
1 or 4	02	80	Unexpected Carriage Unload	Unexpected carriage unlock error was occurred.
4	02	C9	Seek Measure Failed (Lower Limit)	A seek measure value less than lower limit
4	02	CA	Seek Measure failed (Upper Limit)	A seek measure value over than upper limit value
1 or 4	03	00	Peripheral Device Write Fault	A write fault was detected on the drive.
1 or 4	03	80	Write Fault on Write Inhibit Condition	A write fault by issuing WRITE command on write inhibit condition.
4	03	89	Write Cylinder Number Error	A cylinder number injustice was detected after write end.
1 or 4	03	DA	Servo Window Error	A servo window error occurred.
2	04	00	Logical Unit Not Ready, Cause Not Reportable	No drive Ready signal could be detected. The specified drive could not be accessed.
2	04	01	Logical Unit is in Process of Becoming Ready.	Drive is not ready but to be ready soon.
2	04	02	Logical Unit Not Ready, Initializing Command Required	Drive is not ready and waiting for START UNIT Command.
2	04	04	Logical Unit Not Ready, Format in Progress	Drive is not ready because Format Unit is in progress.

2	04 09	Logical Unit Not Ready, Self-test in Progress	Drive is not ready because Self-Test is in progress.
2	04 84	Logical Unit Not Ready, ETF in Progress	Drive is not ready because ETF is in progress.
4	08 00	Logical Unit Communication Failure	A logical unit interface error occurred.
4	08 01	Logical Unit Communication Time Out	A logical unit interface time out error occurred.
4	08 02	Logical Unit Communication Parity Error	A logical unit interface parity error occurred.
1 or 4	08 81	Drive Fault with ATN OFF	A drive fault was detected on ESDI ATN=0.
4	08 83	Drive Error in non Error Factor	Drive error was detected, but there were none error factor.
1 or 4	09 00	Track Following Error	Track Positioning was failed.
1 or 4	09 04	Head Select Fault	Head Select was failed.
1 or 4	09 80	Track Positioning Error	Track Positioning was failed between confirmation of ATN off and issue of MESDI command related to seek.
0 or 1	0B 01	Specified Temperature Exceeded	Temperature value gotten from sensor was over its threshold value.
1	0C 01	Write Error Recovered with Auto Reallocation	A write error has been recovered by sector relocation. Auto-Reallocation process was performed.
3	0C 02	Write Error-Auto Reallocation Failed	A write error has not been recovered. An Auto-Reallocation for a write error was not successful.
1	0C 81	Write Error Recovered with Auto Reallocation, Relocation Threshold- Over	A write error has been recovered by sector relocation. Auto-Reallocation process was performed but a relocation count was over its threshold value.
3	0C 82	Write Error Auto Reallocation Not Execute with Time Out	An Auto Reallocation for a write error was not execute with time out.

3	0C FF	Write Command Terminate with Recovery Time Out	Write processing time exceeded Recovery Time Limit, write processing was terminated..
3	10 00	ID CRC or ECC Error	A CRC error occurred in an ID field.
3	11 00	Unrecovered Read Error	A read error occurred in a data field. (Retries are not applied.)
3	11 01	Read Retries Exhausted	A read error in a data field could not be recovered by retries. (Error correction is not applied.)
3	11 02	Error Too Long to Correct	A read error in data field could not be corrected by ECC.
3	11 04	Unrecovered Read Error-Auto Reallocation Failed	An auto reallocation for a read error was not successful.
3	11 0A	Miscorrected Error	A read error in LBA/CRC field could not be corrected by ECC.
3	11 0B	Unrecoverd Read Error-Recommend Reassignment	A read error in data field could not be corrected by ECC. A reassignment is recommended.
3	11 82	Error Too Long to Multi Symbol Soft Correction	The data field read error could not be corrected using soft correction.
3	11 84	Read Error Auto Reallocation Not Execute with Time Out	An Auto Reallocation for a Read error was not execute with time out.
3	11 D7	Uncorrectable Check Code ECC Error	A read error in check code field could not be corrected by ECC.
3	11 FF	Read or Verify Command Terminate with Recovery Time Out	Read or Verify processing time exceeded Recovery Time Limit, read or verify processing was terminated..
3	12 00	Address Mark Not Found for ID Field	No address mark could be found in an ID field.
1 or 3	13 00	Address Mark Not Found for Data Field	No address mark could be found in a data field.
1 or 3	13 80	Split Data AM Not Found	No address mark could be found in a split data.
1 or 3	14 00	Recorded Entity Not Found	No recorded entity could be found.

1 or 3	14 01	Record Not Found	A sector which has corresponding ID could not be found.
3	14 91	Uncorrectable Data Error on IDRP	Data has been read after an ID recovery procedure (IDRP), but this data has ECC Uncorrectable error.
3	14 93	Data AM Not Found on IDRP	Data read has been retried after an ID recovery procedure(IDRP), but a data AM could not be detected in this data.
3	14 94	Split Data AM Not Found Using Previous Sector ID	Data has been retried with using previous sector ID retry, but a split AM could not be detected in this data.
1	14 98	ECC Correctable Error on IDRP	Data has been read after an ID recovery procedure (IDRP), but this data has an ECC correctable error.
3	14 A1	Previous ID Error on IDRP	An ID error on previous sector was detected when an ID recovery procedure(IDRP) had been initiated.
3	14 B1	Error too Much to Recover Using Previous ID Retry	Previous sector ID retry could not be executed because of two or more ID errors on track.
1 or 4	15 01	Mechanical Positioning error	The number of Cylinder & head is different from the desired position in accessing number check.
1 or 4	15 02	Positioning Error Detected by Read of Medium	A seek operation has completed normally but the positioned address is not the desired one.
1 or 4	15 81	Detected Positioning Time Out	In the number check of cylinder & head, time out occurred.
1	17 00	Recovered Data with No Error Correction Applied	An error has been recovered by retries. (without ECC)
1	17 01	Recovered Data with Retries	An error has been recovered by retries. (without head offset)
1	17 02	Recovered Data with Positive Head Offset	An error has been recovered by retries with a positive head offset.
1	17 03	Recovered Data with Negative Head Offset	An error has been recovered by retries with a negative head offset.
1	17 05	Recovered Data Using Previous Sector ID	An error has been recovered by retries after an ID recovery procedure(IDRP).

1	17 06	Recovered Data without ECC - Data Auto-Reallocated	An error has been recovered by retries (without ECC) and a sector has been reallocated. Auto-Reallocation process was performed.
1	17 07	Recovered Data without ECC - Recommend Reassignment	The error has been recovered without ECC correction. A reassignment is recommended.
1	17 09	Recovered Data without ECC- Data Rewritten	The error has been recovered without ECC correction and data rewritten.
1	17 86	Recovered Data without ECC - Data Auto-Reallocated, Relocation Threshold-Over	Data error has been recovered by ECC correction and a sector has been reallocated. Auto-Reallocation process was performed but a relocation count was over its threshold value.
1	18 00	Recovered Data with Error Correction Applied	Data error has been recovered by ECC correction. (without retries)
1	18 01	Recovered Data with Error Correction & Retries Applied	Data error has been recovered by ECC correction and retries.
1	18 02	Recovered Data - Data Auto-Reallocated	Data error has been recovered by ECC correction (retries may or may not be done) and a sector has been reallocated. Auto-Reallocation process was performed.
1	18 05	Recovered Data-Recommend Reassignment	Data error has been recovered by ECC correction. A reassignment is recommended.
1	18 07	Recovered Data with ECC-Data Rewritten	Data error has been recovered by ECC correction and data rewritten.
1	18 82	Recovered Data - Data Auto-Reallocated, Relocation Threshold-Over	Data error has been recovered by ECC correction and a sector has been reallocated. Auto-Reallocation process was performed but a relocation count was over its threshold value.
1 or 3	19 00	Defect List error	Error exists in defect list.
1 or 3	19 01	Defect List Error Not Available	Defect list could not be used.
1 or 3	19 02	Defect List Error in Primary List	An error occurred during an access to the Primary (P) list

1 or 3	19 03	Defect List Error in Grown List	An error occurred during an access to the Grown (G) list.
5	1A 00	Parameter List Length Error	A parameter list length is incorrect.
B	1B 00	Synchronous Data Transfer Error	An error occurred in synchronous data transfer.
1 or 3	1C 00	Defect List Not Found	Defect list could not be detected.
1 or 3	1C 01	Primary Defect List Not Found	An access to the Primary (P) list has failed.
1 or 3	1C 02	Grown Defect List Not Found	An access to the Grown (G) list has failed.
E	1D 00	Miscompare During Verify Operation	A data compare error occurred during a verification process.
5	20 00	Invalid Command Operation Code	An invalid operation code was specified.
5	21 00	Logical Block Address out of Range	An attempt was made to access beyond the Logical Block Address reported by a READ CAPACITY command (with the PMI bit set to 0).
5	24 00	Illegal Field in CDB	An illegal data was specified in the CDB. E.g.; Reserved bit/Value of non-zero, or Unsupported bit/Value of non-zero.
5	24 80	Download in Progress	A command cannot be executed. (The download in progress.)
5	24 81	Odd Byte Data Out Request in Wide XFR	Odd byte data out request occurred in wide transfer.
5	25 00	Invalid LUN	An unimplemented LUN was specified in the CDB or Identify message.
5	26 00	Invalid Field in Parameter List	An invalid field was specified in a parameter list.
5	26 01	Parameter Not Supported	An unsupported parameter is received.
5	26 02	Parameter Value Invalid	A parameter value is invalid.
5	26 03	Threshold Parameters Not Supported	An unsupported threshold parameters is received.
5	26 04	Invalid Release of Persistent Reservation	An invalid release of persistent reservation.
5	26 80	Microprogram Download Error	Different file from Inquiry type was downloaded in microprogram downloading.

7	27 00	Write Protected	The specified drive was write-protected.
6	29 00	Power On or Reset or Bus Device Reset Occurred	A power-on reset occurred. A Bus Device Reset message was issued. An SCSI bus reset occurred. (Not Occurred)
6	29 01	Power On Reset Occurred	A power-on reset occurred.
6	29 02	SCSI Bus Reset Occurred	An SCSI bus reset occurred.
6	29 03	Bus Device Reset Occurred	A Bus Device Reset message was issued.
6	29 04	Device Internal Reset	A device internal reset occurred.
6	29 05	Mode Changed from LVD to SE	Mode changed from LVD to SE.
6	29 06	Mode Changed from SE to LVD	Mode changed from SE to LVD.
6	2A 00	Parameters Changed	The Mode/Log parameters were altered. E.g., Mode Select command altered parameters. E.g., Mode/Log parameters were reset by a Not Ready to Ready transition of the drive.
2 or 6	2A 01	Mode Parameters Changed	The mode parameter has been changed.
6	2A 02	Log Parameters Changed	The Log parameters have been changed.
6	2A 03	Reservations Preempted	The reservation key has been cleared.
6	2A 04	Reservations Released	The reservation has been cleared.
6	2A 05	Registrations Preempted	The persistent reservation has been preempted.
6	2F 00	Commands Cleared by Another Initiator	The executing or queuing commands have been cleared by another initiator.
2 or 3	31 00	Medium Format Corrupted	The medium has not been formatted properly. It is necessary to reformat the medium with a FORMAT UNIT command.
2 or 3	31 01	Format Command Failed	A Format command completed in the abnormal condition. It is necessary to reformat the medium with a FORMAT UNIT command.

1	31 F0	ETF Cylinder Read Error	The controller detected read error during reading ETF in initial format and judged there was no P-list.
1	31 F1	ETF Cylinder ESDI Defect List Check Error	The controller detected ESDI defect list check error during initial format and judged there was no P-list.
4	32 00	No Defect Spare Location Available	Due to short alternate spares, reassigning blocks could not be processed.
3	32 01	Defect List Update Failure	An updating the Grown (G) list failed.
1	37 00	Rounded Parameter	A parameter value received was not useable as it was, so it was rounded by the controller.
5	3D 00	Invalid Bits in Identify Message	The invalid bits were detected in Identify message.
2	3E 00	Logical Unit Has Not Self-configured Yet	The Self-configuration of Logical Unit has not finished yet.
4	3E 03	Logical Unit Failed Self-Test	Failed to Self-Test.
4	3E 04	Logical Unit Unable to Update Self-Test Log	Unable to update the Self-Test log.
6	3F 00	Target Operating Conditions Have Changed	The operating conditions of target have changed.
6	3F 01	Microcode Has Been Changed	A micro code has been changed.
6	3F 02	Changed Operating Definition	An operating definition has been changed.
6	3F 03	Inquiry Data Has Changed	A Inquiry data has changed.
4	40 00	RAM Failure	Failure of RAM memory.
4	42 00	Power On or Self-test Failure	A power-on diagnostic error occurred. * MPU Error * TIMER Error * ROM Error * Disk Controller Error * ESDI H/W Error * RAM Diagnostic Error * Buffer Diagnostic Error
4	42 80	Hard Register Error at Send Diag Self Test	Hard register diagnostic error was detected at Send Diag Self Test.

B	43 00	Message Error	The message was rejected and the operation could not be continued.
4	44 00	Internal Target Error	A hardware or firmware error was detected in the controller during a command execution.
4	44 01	Cache Allocation Failure	Failed to execute a cache allocation
4	44 80	Incomplete Cache Out	Write data from cache to disk has not completed because of an error.
4	44 81	Unable to Write due to PIN	Unable to write data due to PIN(after Incomplete Cache Out occurred).
4	44 83	Un-reported Error Threshold Exceeded	The number of un-reported errors exceeded threshold.
4	44 90	Management Data Read Error	Failed to read Management Data in the system area.
4	44 92	Directory Data Read Error	Failed to read Directory Data in the system area.
4	44 93	Directory Data Write Error	Failed to write Directory Data in the system area.
4	44 94	Unable to Access System Area	Failed to read/write the system area.
4	44 95	Unable to Write System Area	Unable to wtite the system area due to a lack of valid track.
4	44 96	Unable to Write Management Data	Unable to wtite the system area due to a lack of valid Management Data.
4	44 97	Master Data Read Error	Failed to read Master Data in the system area.
4	44 98	Can't Multi Track Write Remain Trackless	Unable to write to Multi Track in the system area due to remain trackless.
4	44 99	Multi Track Write Error	Failed to write to the whole Multi Track in the system area.
4	44 9A	Multi Track R/W Parameter Error	Parameter error was detected in multi track R/W.
4	44 9C	Read CRC Check Error	A CRC check error occurred on reading from the system area.
4	44 9D	Write CRC Check Error	A CRC check error occurred on write to the system area.
4	44 9E	Master Data Write Error	Failed to write Master Data in the system area.
4	44 9F	System Area Access Error	Failed to read/write the system area due to drive time out.
4	44 A0	Internal Target Error	The target sector was not found in reassign operation.

4	44 A1	Reassign Data Restore Fail	Failed to recover data in reassign operation.
4	44 A2	Reassign ID Verify Error	ID verify error occurred in Reassign target track.
4	44 A5	Reassign Data Save Error	Error occurred on data saving or recovery operation of Reassign.
4	44 A6	Reassign ID Write Error	Failed to write ID of Reassign target sector.
4	44 B1	SCSI FIFO Overrun /Underrun Error	Overrun / underrun error at SCSI FIFO was detected.
4	44 B2	Illegal Command	The Command for SPC was failed as Illegal Command.
4	44 B3	Illegal Write	The write demand occured at the write inhibit status.
4	44 B4	Synchronous Offset Error	Synchronous offset error was detected. (Not Occurred)
4	44 B5	Ch1 LBA Error	LBA error at Ch1 was detected.
4	44 B6	Ch1 BCRC Error	BCRC error at Ch1 was detected.
4	44 B7	SCSI FIFO Parity Error	SCSI parity error was detected.
4	44 B8	Unexpected Event Error	Unexpected Event error was detected.
4	44 BC	Host Buffer Error	Error was detected in Host Buffer circuit.
4	44 BF	Unexpected Error	SCSI controller detected unexpected error.
4	44 C0	Disk Data Buffer Parity Error	Data Buffer Parity error was detected.
4	44 C1	DMA Pipeline Error	DMA Pipeline was started on Very Busy status.
4	44 C2	Disk FIFO Overrun /Underrun Error	Disk FIFO Overrun / Underrun was detected.
4	44 D0	HDC Sequencer Setting Mismatch	Missmatch occured at comparing with the value set in HDC Sequencer.
4	44 D1	HDC DMA Next Condition Full	HDC DMA current condition has completed, but DMA cannot be set because next condition is full.
4	44 D2	Offline ECC Correction Time OUT	HDC was started to execute offline one burst correction, but no completion of HDC caused timeout of 1ms.
4	44 D3	HDC Time OUT	HDC was started (R/W etc.), but no completion of HDC caused timeout of 1 s.

4	44 D4	HDC Stop	HDC stopped injuriously
4	44 D5	Wrap Error	Wrap error was detected.
4	44 D6	Disk Port Parity Error	Disk Port Parity Error was detected.
4	44 D7	Ch0 Check Code Error	LBA/CRC Check code error was detected in Ch0.
4	44 D8	Write After Read Check Error	Write after read check error occurred.
4	44 DA	DF Interrupt Status Resister Error	Error was detected in DF Interrupt Status Resister.
4	44 DB	ECC status Resister Error	Error was detected in ECC Status Resister.
4	44 DC	BC Interrupt Status Resister Error	Error was detected in BC Interrupt Status Resister.
4	44 DD	Hardware Error at ESDI Standard Status	Hardware error was detected in standard status.
4	44 DF	Novalid Error Status For Drive ATN	There ware no valid stasus for Drive Attention.
4	44 F1	Invalid Logical Cylinder Count	Invalid Logical Cylinder Number was reported from drive control program. (exceed maximum Logical Cylinder Number)
4	44 F2	Head Health Check Error	Error was detected in Head Health Check.
4	44 F3	Program & Parameter Down Load Compare Error	A compare error was detected in micro program & parameter downloading.
4	44 F4	Hardware Error at Controller Self Test	Hardware error was detected at the controller self test.
4	44 F8	Error in Drive Microcomputer	Error was detected in Drive Microcomputer program overwriting
4	44 F9	Error in Flush ROM	Error was detected in Flush ROM overwriting.
4	44 FA	Module Sum Error in ROM Mode	SUM check error was detected in ROM overwriting.
4	44 FE	Error in S-RAM Marks Download Unable	Unable to download micro program for S-RAM error.
4	44 FF	Detected Firmware Error	A firmware error which should be reported with Check Condition Status was detected.

B	45 00	Select/Reselect Failed	A Select/Reselect time out was occurred. An invalid selection was detected.
B	47 00	SCSI Parity Error	A parity error occurred on the SCSI interface.
B	47 01	Data Phase CRC Error Detected	A CRC error occurred in Data Phase.
B	47 03	Information Unit CRC Error Detected	A CRC error occurred in Information Unit.
B	48 00	Initiator Detected Error Message Received	An Initiator Detected Error message was received from an initiator.
B	48 80	SCSI Phase Retry Out	A SCSI phase retry out was occurred.
B	49 00	Invalid Message Error	An invalid message was received.
B	4A 00	Command Phase Error	An error occurred in Command Phase.
B	4B 00	Data Phase Error	An error occurred in Data Phase.
4	4C 00	Logical Unit Failed Self-configuration	A loading of microcode or parameters failed during controller initialization.
4	4C 80	Ram Configuration Load Error	Failed to configuration load for ram initializing.
4	4C 81	Program Revision Check Error	Failed to download micro program for program revision check .
4	4C 82	Module Not Found	Failed to download micro program for program size.
4	4C 83	Module Sum Error	SUM check error was detected in program down loading.
4	4C 84	Defect Parameter Load Error	A loading of defect parameter failed during controller initialization
B	4E 00	Overlapped Commands Attempted	Both tagged command and untagged command from the same initiator are issued at a same time. - A tagged command which specifies the same tag number is issued from the same initiator. - An untagged command is issued from the same initiator which has issued another untagged command.
5	55 04	Insufficient Registration Resources	The reservation key registration failed.
1	5B 00	Log Exception	The Log exception was detected.

6	5B 01	Threshold Condition Met	The Log condition has met threshold condition.
1	5B 02	Log Counter at Maximum	The Log counter have reached to the maximum value.
1	5B 03	Log List Codes Exhausted	The Log List codes were exhausted.
0 or 1 or 6	5D 00	Failure Prediction Threshold Exceeded	The informational exception conditions occured.
0 or 1 or 6	5D FF	Failure Prediction Threshold Exceeded (False)	The false informational exception conditions occured.
1	80 00	Read with Pin Hit	Data is read, but this data has Pin.
4	94 00	Auto-Reallocation Fail at No REC Sector	Auto-Reallocation failed at no REC sector.
1	AE 00	Spare Sector Less Than Threshold	Spare sector for relocation is less than threshold, and relocate operation will be unable to be executed.
4	E0 00	ETF Failed	A ETF completed in the abnormal condition

Table 6.4 Field Pointer

Byte \ Bit	7	6	5	4	3	2	1	0
15	SKSV	C/D	Reserved 0	0	BPV	Bit Pointer		
16	Field Pointer (MSB)							
17	Field Pointer (LSB)							

When the sense key is Illegal REQUEST and the SKSV bit is set to 1, the Sense-Key Specific field (Byte 15-17) defines the contents as shown in Table 6.4. If the C/D (Command / Data) bit is set to 1, it indicates that the CDB contains an invalid parameter. If the C/D bit is set to 0, it indicates that the transferred data during DATA OUT phase contain an invalid parameter. The BPV (Bit Pointer Valid) bit of 1 indicates that the Bit Pointer field contents is determined. The BPV bit of 0 indicates that the Bit Pointer is undetermined.
The Bit Pointer is effective when the BPV bit is set to 1 and indicates the bit position of an invalid parameter which is detected first.
The Field Pointer indicates that the byte position of an invalid parameter which is detected first.

Table 6.5 Actual Retry Count

Byte \ Bit	7	6	5	4	3	2	1	0
15	SKSV	Reserved 0	0	0	0	0	0	0
16	Actual Retry Count (MSB)							
17	Actual Retry Count (LSB)							

When the sense key is RECOVERED ERROR, MEDIUM ERROR or HARDWARE ERROR and the SKSV bit is set to 1, the Sense-Key Specific field defines the contents as shown in Table 6.5.
The Actual Retry Count indicates the number of retries actually performed by the controller. If the error is not regarded as a subject of recovery using retries, the value of 0000_H is indicated in the field.

Table 6.6 Progress Indication

Byte \ Bit	7	6	5	4	3	2	1	0
15	SKSV	Reserved 0	0	0	0	0	0	0
16	Progress Indication (MSB)							
17	Progress Indication (LSB)							

When the sense key is NOT READY and the SKSV bit is set to 1, the Sense-Key Specific field (Byte 15-17) defines the contents as shown in Table 6.6.
Progress Indication gives a general indication of the amount of progress made during
format. This returned value is the numerator of a fraction whose denominator is 65536.
A Progress Indication of 0000_H indicates that Format Unit is not started.
A Progress Indication of $FFCC_H$ or greater (up to $FFFF_H$) indicates that Format Unit
completed.

6.2 SENSE DATA SET / RESET CONDITIONS

The sense data is managed for each LUN and host computer. Accordingly, the controller can execute commands issued from other host computers without clearing any pending sense data for the current host computer. If the tagged command, however, is used, the controller sometimes stops executing the command from the other host computers.

6.2.1 SETTING CONDITIONS

Sense data is loaded whenever a condition that needs the report of sense data occurs. It is valid for the CHECK CONDITION status set during the execution of the preceding command. For catastrophic errors (see 3.4 SCSI BUS ERROR CONDITIONS), however, sense data is generated even if no CHECK CONDITION status is presented.

6.2.2 RESETTING CONDITIONS

The sense data is retained within the controller until one of the following conditions occurs :

- The sense data is transferred to the host computer by issuing a REQUEST SENSE command.
- A command other than the REQUEST SENSE command is received.
- An Abort message is received.
- An Abort Tag message is received.
- An Clear Queue message is received.
- A reset condition is generated (by a Bus Device Reset message or a reset or power-on reset).